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FURUNO

SERVICE MANUAL

MARINE RADAR

MODEL 1700

FURUNO ELECTRIC CO., LTD.
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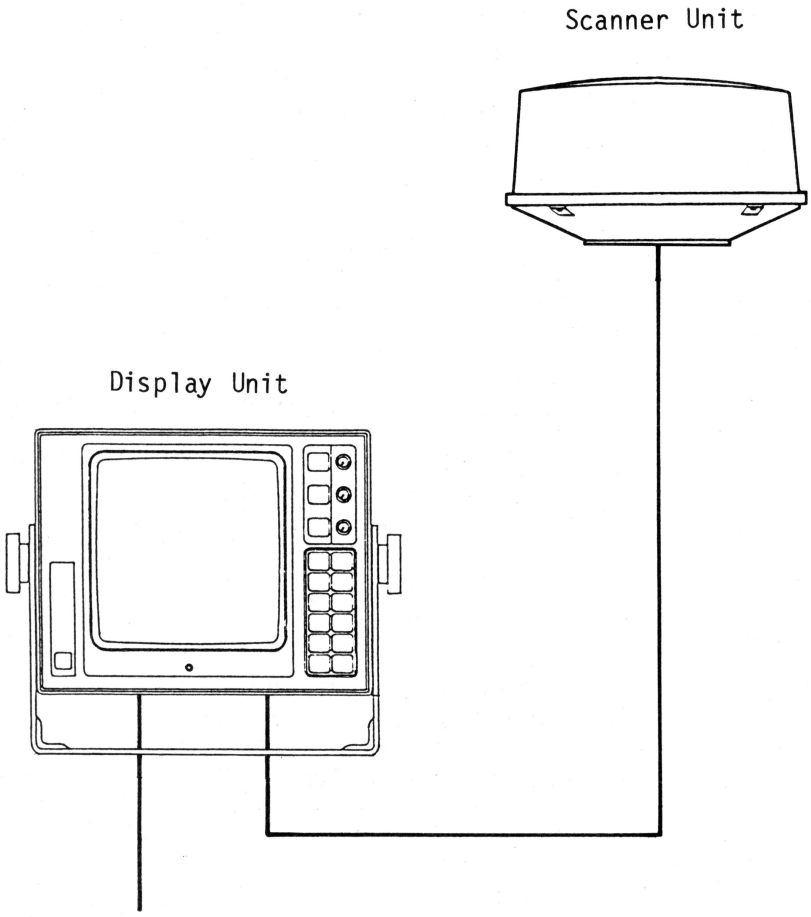
INTRODUCTION

The basic system of the Model 1700 radar consists of a display unit and a scanner unit, and operates from 12/24VDC ship's mains. The scanner unit is identical with that for FR-801D.



SPECIFICATIONS OF MODEL 1700

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SCANNER UNIT

1. Radiator: Slotted Waveguide Array (housed in ø610mm radome)
2. Radiator Length: 54cm
3. Horizontal Beamwidth: 4° typical
4. Vertical Beamwidth: 25°
5. Sidelobe Attenuation:
   Within ± 20° of mainlobe: -18dB
   Outside ± 20° of mainlobe: -23dB
6. Polarization: Horizontal
7. Antenna Rotation: 24 r.p.m. nominal

TRANSCEIVER MODULE (Contained in the radome)

1. Transmitting Tube: Magnetron 9M302/E3515 or 9M332
2. Frequency & Modulation: 9410MHz ± 30MHz, PON
3. Peak Output Power: 3kW nominal
4. Pulselength & Pulse Repetition Rate:

Item \ Range	0.25	0.5	1	2	4	8	16
Pulse Repetition Rate	Approx. 3360Hz			Approx. 840Hz			
Pulselength	0.08us (Short)			0.5us (Long)			

5. Modulator: SCR Line Type Pulse Modulator
6. I.F.: 60MHz
7. Tuning: Manual
8. Receiver Front End: MIC (Microwave IC)
9. Bandwidth: 7MHz/3MHz
10. Duplexer: Circulator and Limiter

DISPLAY UNIT

1. Indication System: PPI, Daylight Display
2. Picture Tube: 9-inch rectangular CRT

3. Range:	0.25	0.5	1	2	4	8	16	n.m.
4. Range Ring Interval:	0.125	0.125	0.25	0.5	1	2	4	n.m.
5. Number of Rings:	2	4	4	4	4	4	4	pcs.

6.	Bearing Resolution:	4° typical
7.	Bearing Accuracy:	Better than 1°
8.	Range Discrimination:	Better than 33m
9.	Minimum Range:	Better than 33m
10.	Range Ring Accuracy:	1.5% or 70m, whichever is the greater
11.	VRM Accuracy:	1.5% or 70m, whichever is the greater
12.	Mark Indication:	Heading Mark, Bearing Scale, Range Ring, VRM, EBL
13.	Numeral/Character Indication:	Range, Range Ring Interval, EBL Bearings, VRM Ranges, Interference Rejection (IR), Rain Clutter Rejection (FTC), ST-BY
14.	Interference Rejector:	Built in

ENVIRONMENT CONDITION

1. Vibration:

Total Amplitude	Vibration Cycle
± 1.6 mm	1 to 12.5Hz
± 0.38 mm	12.5 to 25Hz
± 0.10 mm	25 to 50Hz

2. Ambient Temperature: Scanner Unit -------- -25°C to +70°C
   Display Unit -------- -10°C to +55°C

3. Humidity: Relative humidity, 95% at +40°C

POWER SUPPLY & POWER CONSUMPTION

10.2VDC - 31.2VDC, 45W

COATING COLOR

1. Display Unit ----- Munsell 5Y9/1.5 for Cabinet (Dark Grey),
   Munsell N3.0 Newtone No.5 for Control Panel

2. Scanner Unit ----- Munsell N9.5 for Radome,
   Munsell 2.5PB 3.5/10 for Radome Base

WEIGHT

1. Display Unit ----- 6.2kg

2. Scanner Unit ----- 11kg

1.1 Display Unit

PROCESSOR Board (SPU-6172)

As shown in Fig.1-1, the signal processor board contains the following main blocks:

(1) FTC Circuit
(2) A/D Converter
(3) Phase Lock Loop (PLL) Circuit
(4) Clock Generators
(5) ROM and RAM
(6) Digital Signal Processor
(7) Microprocessor
(8) X/Y Coordinate Converter and H/V Synchro Pulse Generator
(9) Output Circuit

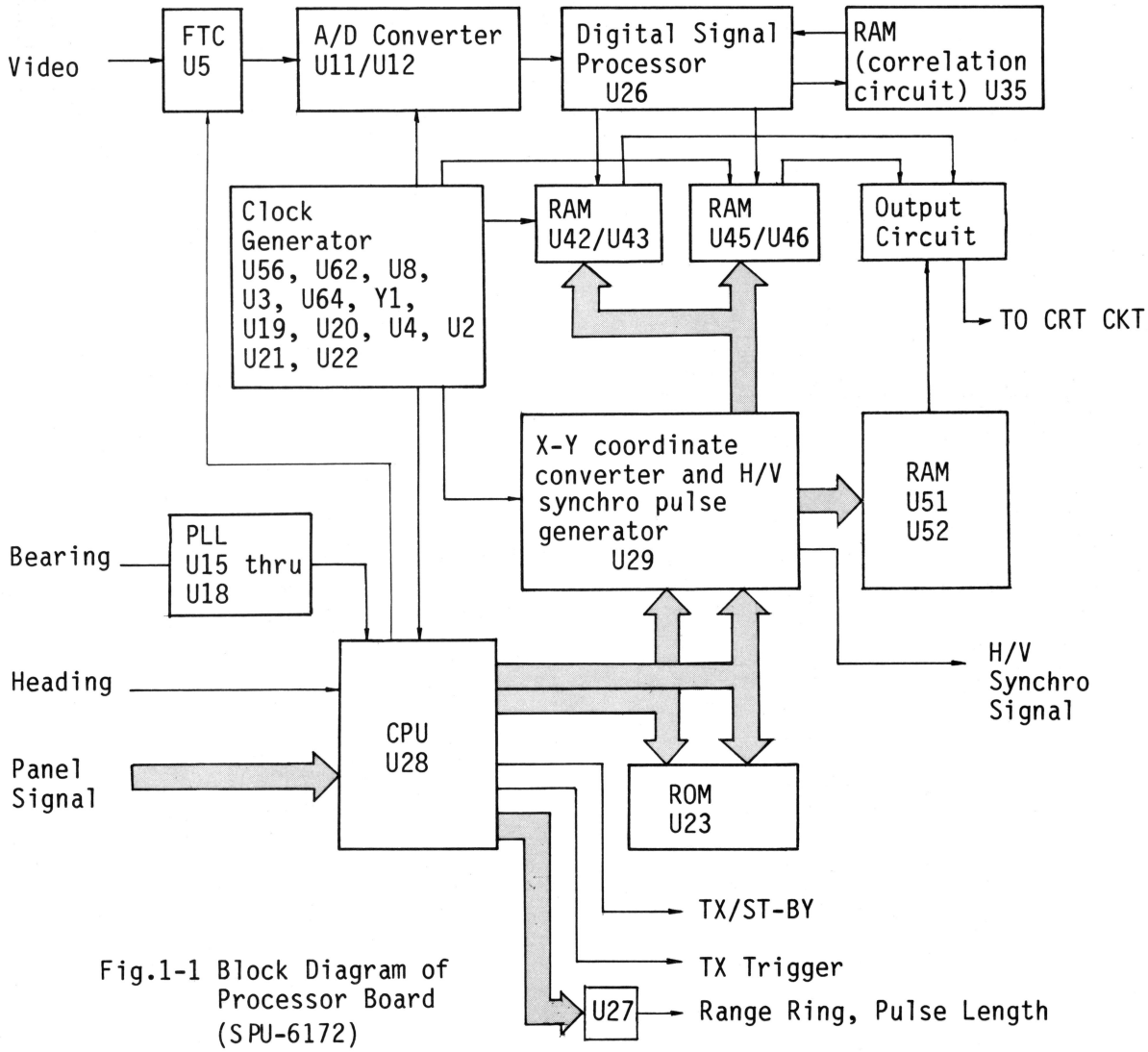


Fig.1-1 Block Diagram of Processor Board (SPU-6172)

FTC Circuit:

The video signal from the transceiver is applied to FTC circuit U5. When the FTC is turned off, the signal bypasses the FTC circuit in U5 via relay K1. When the FTC touchpad is pressed, the "H" signal derived from U27 #19 is sent to U5 #2 to energize relay K1. Thus, the video signal applied to U5 #4 is differentiated by a capacitor and a resistor in U5. The output of U5 is #9, #11, #12 and #13.

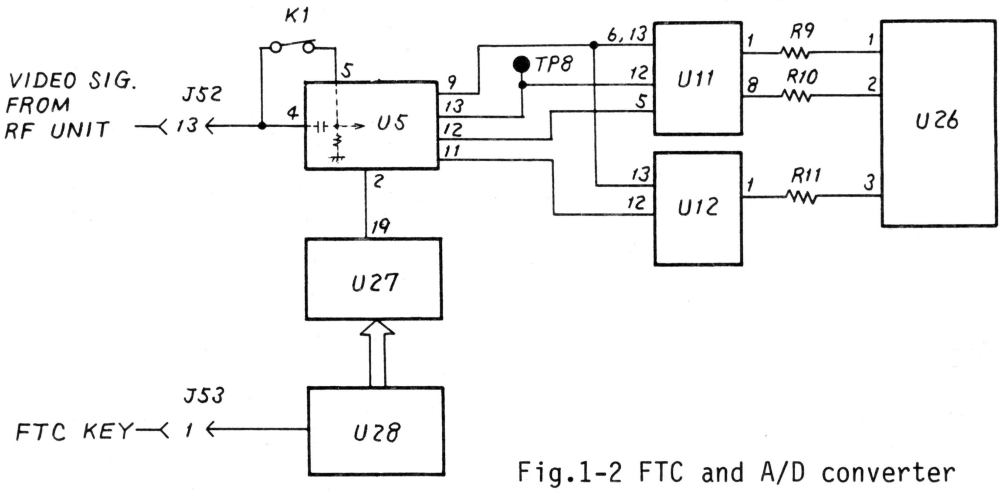


Fig.1-2 FTC and A/D converter

A/D Converter:

U11 and U12 are A/D converters. The analog signal derived from U5 is converted into a digital signal. The digital signals in four levels are produced at U11 #1 and #8, and U12 #1, and then sent to digital signal processor U26 #1, #2 and #3.

Phase Lock Loop (PLL) Circuit:

The circuit consisting of U15 through U18 takes the bearing signal of 180Hz to produce 4096 pulses per scanner revolution.

The output of PLL circuit, U9 #2, is connected to U28 #8.

Clock Generators:

There are two reference oscillators: 38.85MHz and 21.5MHz. The 38.85MHz oscillator consists of U56 and U62 and its output is sent to U4 #11 to generate the TX trigger. The 38.85MHz signal is also sent to counter U8 #1 to produce the clock for digital signal processor U26.

The 21.5MHz signal is used as a clock for the CPU (U28). The clock of the memory circuit is a divided signal of 21.5MHz.

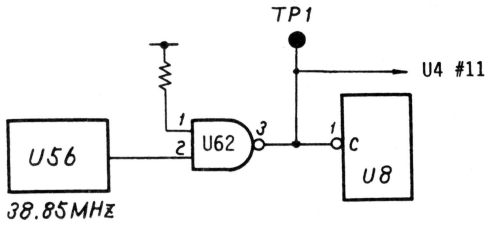


Fig.1-3(a) 38.85MHz Oscillator

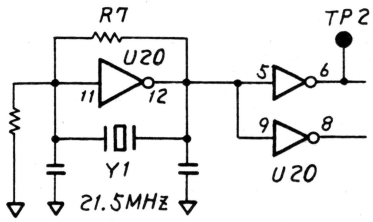


Fig.1-3(b) 21.5MHz Oscillator

ROM and RAM:

The program software for the processor is contained in Eraseable PROM (U23) and the temporary storage of data is held in the RAM.

U35 is used for video signal correlation to reject interference or noise. U51 and U52 are used to store the character data, and U42/U43 and U45/U46 are used to store the video data.

Digital Signal Processor:

The digital video signal is processed by U26 according to the range selection and the setting of the interference rejector touchpad.

Microprocessor:

The microprocessor(CPU) U28 controls the timing of the devices connected to it and processes the data to and from them. The CPU timing is controlled by the clock generator. The clocks for the TX trigger and delay circuits are generated at U28 #15 and #9 respectively. The range ring and pulse length signals are generated at U27 #2 and #5 respectively by using the data from U28.

X-Y Coordinate Converter and
H/V Synchro Pulse Generator:

U29 converts the polar coordinate of the target echoes expressed by both the distance and bearing data into the X-Y coordinate to store echo data in the RAM.

The other function of U29 is to generate the horizontal/vertical synchro pulses.

Output Circuit:

The digital video signal is converted into an analog signal and sent to the CRT circuit from U24 #6 through J56 #4.

The brilliance control signal from the keyboard is applied to U33 #3 through R27 and U10 #13(Input)/#12(Output) to control the level of the video signal.

MAJOR SIGNALS

The following shows the flow of major signals in the processor board. This might be helpful for service.

Trigger;

U28 #15 (TX Clock) -- C13 -- U10 #11(Input)/#10(Output) -- U10 #9/#8 -- U3 #13/#11 -- U4 #10

U56 (38.85MHz Oscillator) -- U62 #2/#3 -- TP1 -- U4 #11/#9 -- U55 #2/#3 -- R15 -- Q1 and Q2 bases -- Q1 emitter -- J52 #1

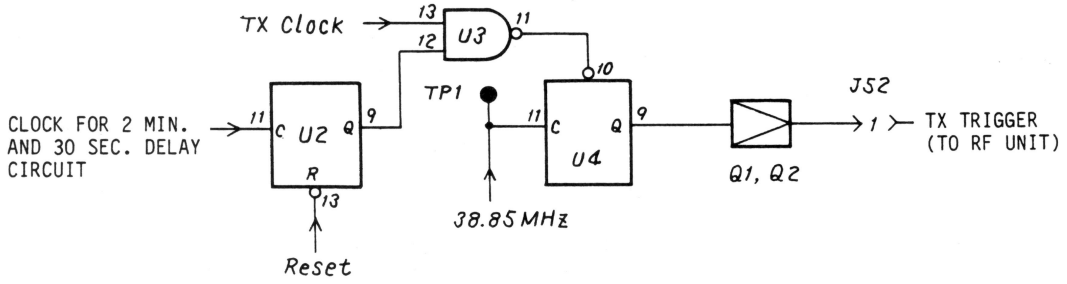


Fig.1-4 TX Trigger Generator Circuit

Two minutes and 30 seconds delay circuit;

U28 #9 -- U14 #5/#4 -- U2 #11/#9 -- U3 #12

Range Ring Signal;

U27 #2 -- U41 #2/#3 -- U41 #10/#8 -- RAMs (U42 #3 and U43 #2)

Pulse length;

U27 #5 -- U55 #13/#11 -- R25 -- Q4 base -- R26 -- J52 #7 -- RF Unit

Brilliance Control Signal;

Keyboard #6 -- J53 #6 -- R27 -- U10 #13/#12 -- U33 #3

Reset Pulse;

U10 #1/#2 --- U10 #3/#4 -- U2 #13, U4 #13, U26 #15 and U55 #4

--- U10 #5/#6 -- U28 #6, U29 #47 and U33 #1

Clock Generator (1)

U56 (38.85MHZ oscillator) -- U62 #2/#3 -- TP1 -- U8 #1/#5 -- U8 #13/#7 -- U3 #1/#3 -- U26 #19

Clock Generator (2)

Y1 (21.5MHz) -- U20 #9/#8 -- U19 #11/#8 -- U20 #1/#2 -- U4 #4 (set), U22 #1 (clock) and U21 #9

Y1 -- U20 #5/#6 -- TP2 -- U9 #3/#4 -- U30 #9

Y1 -- U20 #9/#8 -- U21 #2/#15 --- U4 #3/#5 -- U26 #24 and U30 #3
--- U4 #3/#6 -- U28 #3

Video;

J52 #13 -- U5 #4/#11, #12 and #13 --- U11 #5 and #12/#1 -- R9 -- U26 #1

--- U11 #5 and #12/#2 -- R10 - U26 #2

--- U12 #12/#1 -- R11 -- U26 #3

Bearing;

180Hz from scanner unit -- J52 #6 -- U13 #2/#1 -- U16 #14/#4 -- U14 #7/#6 -- U18 #2/#11 -- U9 #1/#2 -- U28 #8

(PLL circuit is composed of U15 thru U18.)

Heading Signal;

from scanner unit -- J52 #5 -- U5 #5/#7 -- U14 #9/#10 -- U28 #21 and U29 #46

-- U14 #11/#12 -- J57 #9

DESCRIPTION OF CHECK POINTS

TP1	38.85MHz
TP2	21.5MHz
TP3	Video Signal (Digital)
TP4	Video Signal (Digital)
TP5	Enable Signal to U26
TP6	Ground
TP7	Ground
TP8	Video Signal (Analog)

SIGNAL TO THE CRT CIRCUIT

The following shows the waveforms to be sent to the CRT circuit. The video signal is measured at J56 #4.

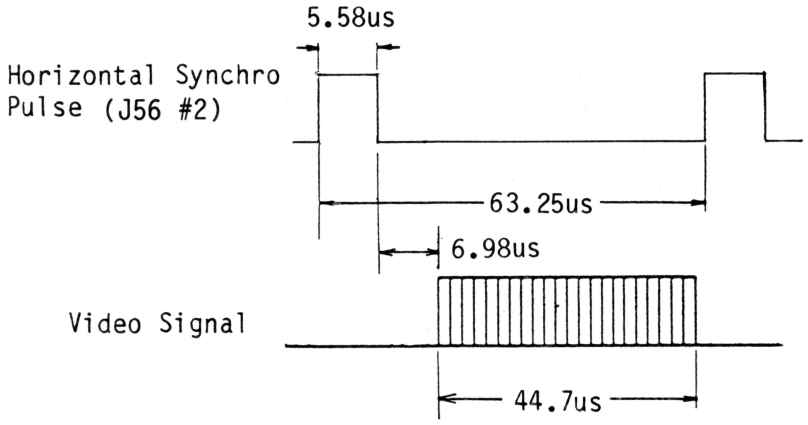


Fig.1-5 Horizontal Synchro Pulse and Video Signal

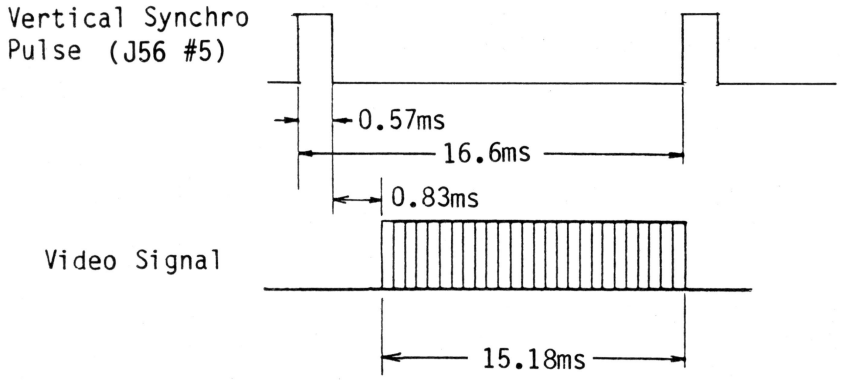


Fig.1-6 Vertical Synchro Pulse and Video Signal

POWER SUPPLY Circuit

The power supply circuit is made up of PWM (Pulse Width Modulator) inverters employing switching regulation techniques, rectifiers and protectors. The main PWM inverter universally operates on ship's mains of 10.2 thru 31.5Vdc, while the sub-inverter operates on the output of the main inverter. Against the variation of the mains voltage and load condition, the inverter regulates the DC line voltage output by changing the width of its output pulse.

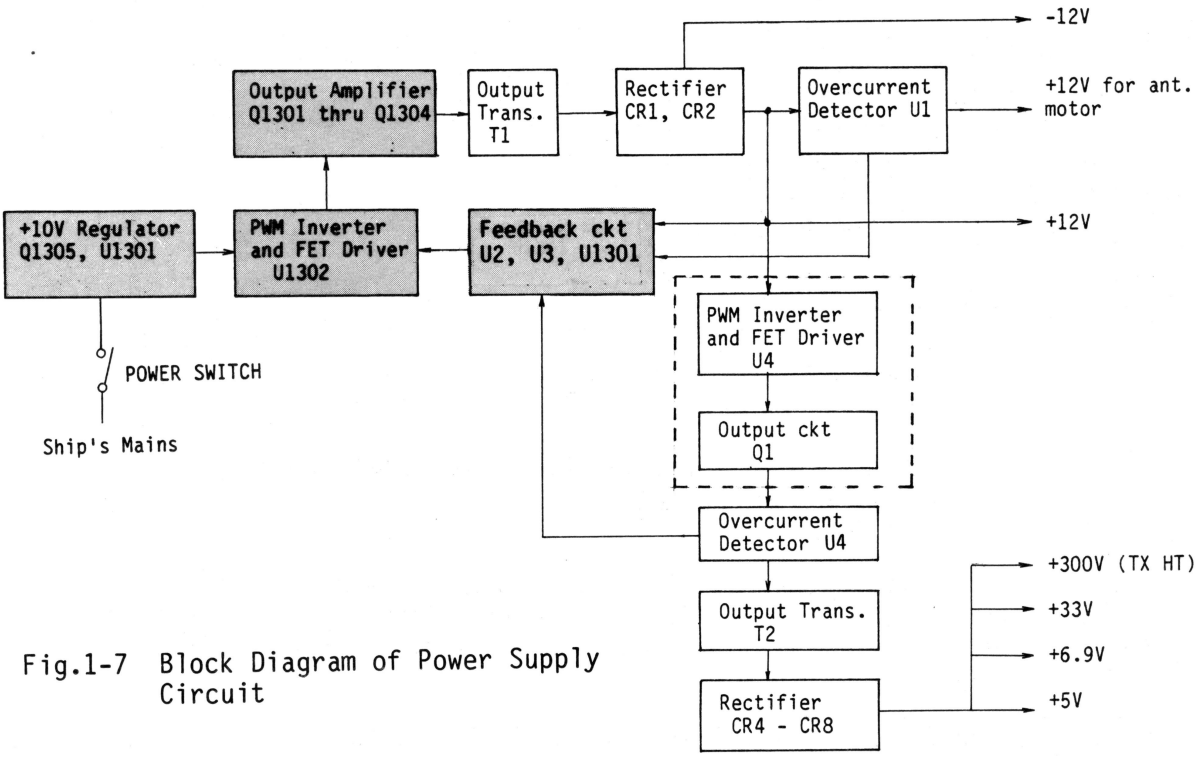


Fig.1-7 Block Diagram of Power Supply Circuit

Main PWM Inverter:

The PWM inverter consists of switching regulator control IC U1302, +10V regulator Q1305/U1301, pulse width control circuit U2, output amplifier Q1301 thru Q1304.

Regulated +10V is derived at Q1305 collector and applied to switching regulator control IC U1302 #11. Fig.1-8 shows a simplified drawing of the linear regulator.

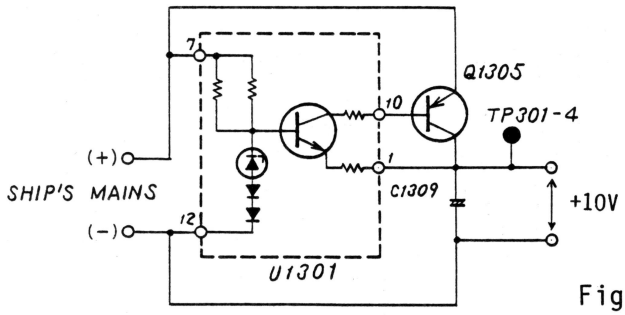


Fig.1-8 +10V Regulator

The figure below shows the block diagram of switching regulator control IC U1302.

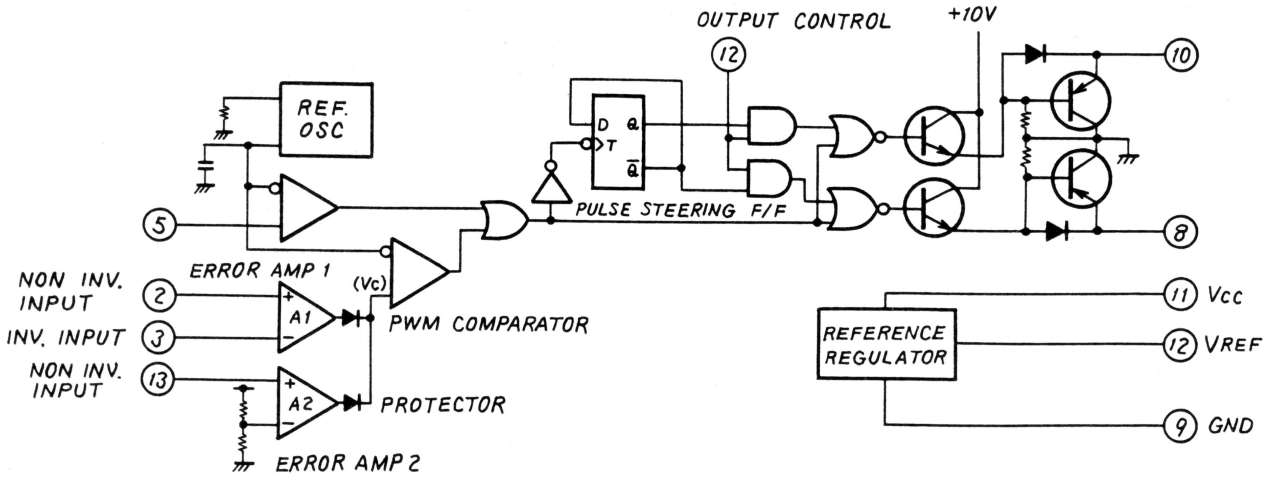


Fig.1-9 Switching Regulator Control IC (U1302)

The reference oscillator in U1302 is a sawtooth wave generator of 90kHz. In the switching regulator circuit, the dc output line voltage is maintained constant against fluctuation of the supply voltage by varying the pulse width of the output waveform.

Of the two error amplifiers A1 and A2 in U1302, A1 is used to control pulse width and A2 acts as a protector.

The pulse width control circuit shown in Fig.1-10 stabilizes dc output line voltage by moving up and down the slice level for the reference oscillator output sawtooth wave, that is, by converting mains and load variations into the variation of pulse width.

The voltage variation on the +12V line is detected by photo coupler U2 and fed back to error amplifier A1 in U1302.

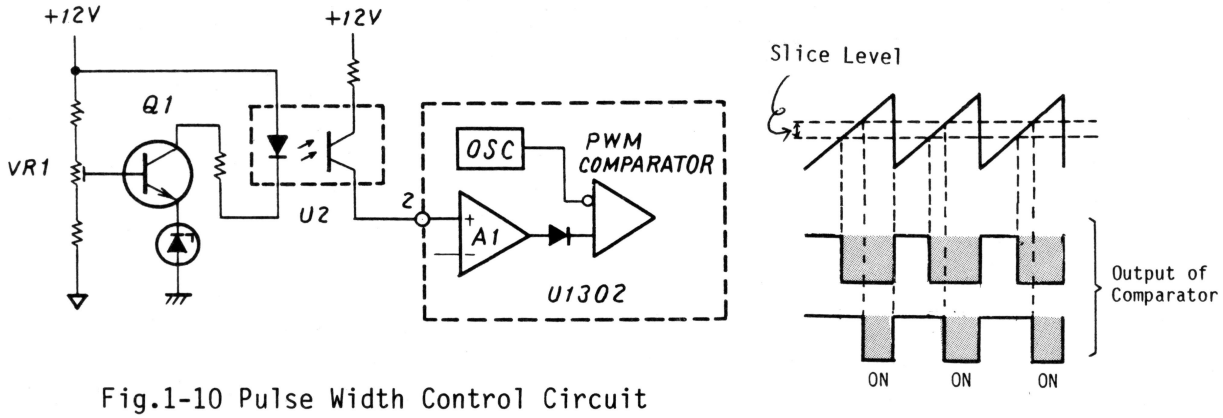


Fig.1-10 Pulse Width Control Circuit

If voltage on the +12V line changes for some reason, the current in the light emitting diode and then the voltage on the non-inverting input pin (+) of the error amplifier changes accordingly. The difference of voltage between the inverting (-) and non-inverting (+) pins of A1 is amplified and the resultant dc output is fed to the PWM comparator in U1302 to move the slice level of the sawtooth wave as shown in Fig.1-10.

The +12Vdc is measured at J1302 #1(+) and #3(-) and adjusted by VR1.

Sub PWM Inverter:

The control IC of the sub PWM inverter is U4, which contains a reference oscillator of 45kHz. The reference voltage of U4 is +12V produced from the main PWM inverter.

Protector:

(1) Reverse Polarity Protection

Diode CR1301 is provided to protect the power supply circuit from being damaged due to reverse polarity of the ship's mains. When the ship's mains is connected to J1311 in reverse polarity, CR1301 goes on, resulting in the blowing of fuse F1351.

(2) Ship's Mains Overvoltage Protection

If the ship's mains rises to approximately 37V, the voltage at the non-inverting pin (+) of the error amplifier in U1301 becomes higher and its output goes positive. Thus, the output of A2 in U1302 also goes positive. Since the positive voltage is higher than the amplitude of the sawtooth wave in the output of the reference oscillator, the output of the PWM comparator is held "L" at all times and the sawtooth wave is blocked to suspend operation of the inverter.

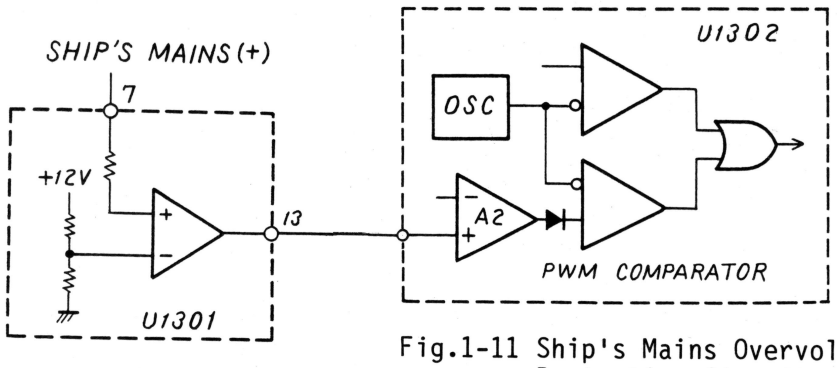


Fig.1-11 Ship's Mains Overvoltage Protection Circuit

(3) Overcurrent of Sub PWM Inverter

The current in the sub PWM inverter is monitored at Q1 drain. If the current increases, operation of the main PWM inverter is suspended by blocking the sawtooth wave as shown in the following sequence.

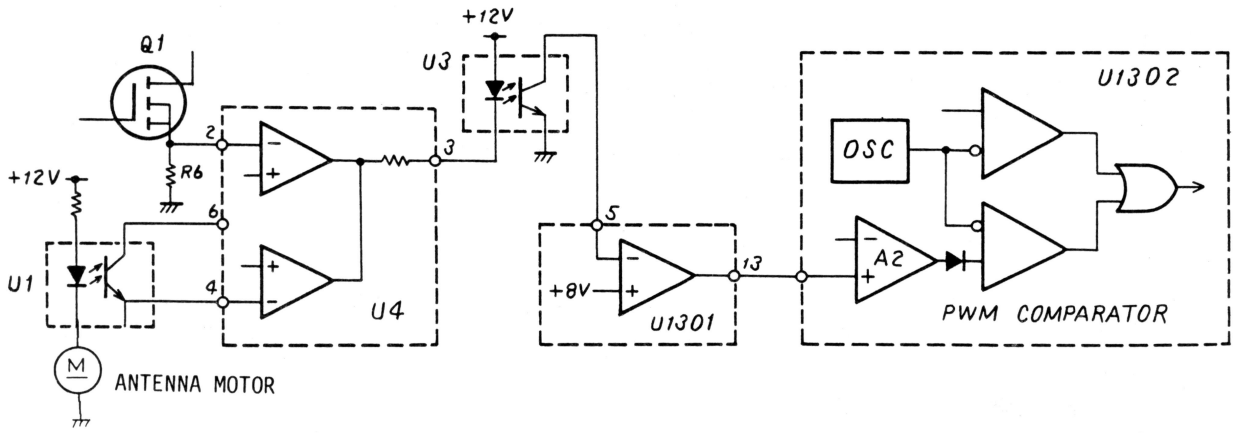


Fig.1-12 Overcurrent Protection Circuit for Sub PWM Inverter and Antenna Motor

The higher current through R6 produces a higher voltage across R6 and the output of the error amplifier in U4 goes negative, resulting in the activation of photo coupler U3.

With U3 active, the output of the comparator in U1301 becomes "H" state, and the output of the comparator (A2) in U1302 becomes "H." Thus, the sawtooth wave cannot pass OR gate in U1302.

(4) Overcurrent of Antenna Motor

Overcurrent (more than approximately 2A) in the antenna motor circuit is detected by U1. See Fig.1-12.

1.2 Scanner Unit

Modulator Trigger Circuit & Modulator

Modulator trigger circuit generates pulses that fire SCR CR803, and the function of the modulator is to produce a narrow high tension pulse that drives the magnetron. See Fig.1-13.

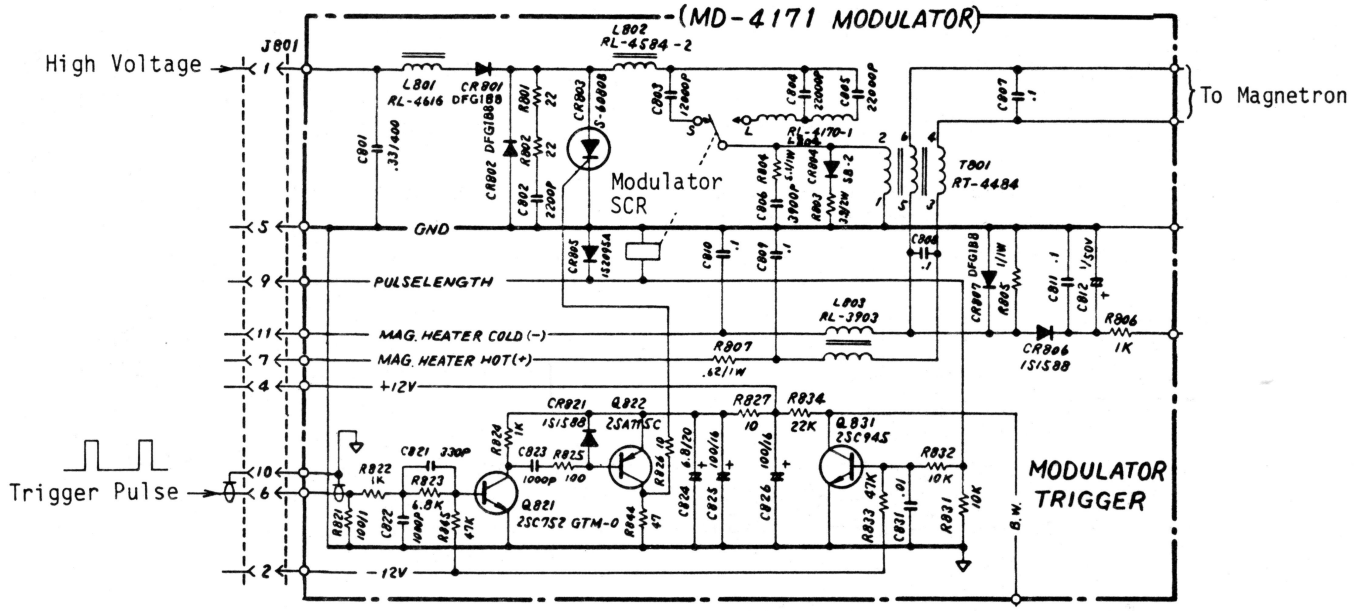


Fig.1-13

The modulator trigger circuit is composed of Q821, Q822 and the associated components. When the TX trigger pulse from the display unit is sent to the base of Q821, Q821 turns on and a negative going pulse shown in Fig.1-14 appears at its collector. The negative going pulse is differentiated by C823, R825 and CR821, and then only a negative going differentiated waveform appears at the base of Q822 since a positive one is eliminated through CR821. Consequently, a positive going pulse (Modulator Trigger Pulse) is fed from the collector of Q822 to the modulator SCR.

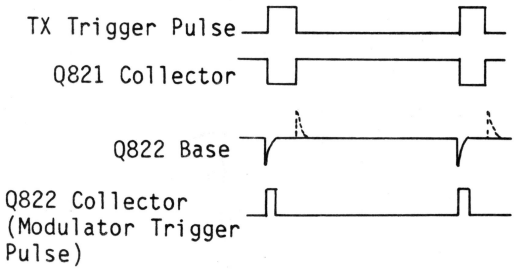


Fig.1-14

The +300V power applied to the modulator is doubled by the electromotive force developed across the charging choke L801, and about 600V induced at the anode of CR801 charges the pulser capacitors C803/C804/C805 in the pulse forming network C803/C804/C805/L804. The charging speed of the pulser capacitors is determined by the series resonance circuit composed of L801 and the pulse forming network, and the time to full charge is roughly given by the equation $T = 2\pi\sqrt{L \times C}$, where L represents L801 and C, capacitors C804 and C805 in long range and C803 in short range.

CR801 prevents the energy stored in the pulse forming network from discharging to the +300V line.

With CR803 fired by the positive going pulse derived from Q822 collector, whole energy in the pulse forming network is rapidly discharged through L802, CR803 and the primary winding of the pulse transformer T801.

Since the characteristic impedance of the pulse forming network and the primary winding of T801 is matched, a half of the network voltage is developed across the T801's primary winding. The voltage across the transformer primary winding (Primary to secondary winding ratio is 1 to 15.) is boosted up to 4.7KV and applied to the cathode of the magnetron.

If the modulator load does not match the network impedance, there will be reflected inverse voltage remaining in the network capacitors after the discharging cycle. At the end of the next charging cycle, the network will be charged to normal voltage level but less the reflected voltage. The action is cumulative and the reflected voltage could cause erratic operation or damage to modulator and transmitter components. The diode CR802 shunts the pulse forming network to prevent the inverse voltage built up across the network.

Due to the time lag between application of the pulse and the time it takes the magnetron to draw current, a spike is produced. R804 and C806 are connected as a load circuit for the modulator. This CR network slows down the rate of rise of the modulator output pulse and prevents the development of spike.

CR804 absorbs the counter electromotive force that is developed at the moment CR803 turns off, protecting CR803 from damage.

The coil L802 helps to hold off the discharge current until CR803 is brought to fully conducting state. As soon as CR803 is fired, its anode voltage falls rapidly to zero and discharge current from the pulse forming network begins to flow at a slow rate due to the relatively high inductance value of L802. After a certain period of time, L802 saturates and inductance falls rapidly to a negligible value so that the large amount of discharge current may flow.

R801, R802 and C802 are to protect CR803 from failure due to transient voltage.

Duplexer and Mixer

Since the radar system uses a single antenna for transmission and reception, an efficient device is required for switching the transmitter and the receiver. This radar employs circulator HY801 for this purpose. See Fig.1-15.

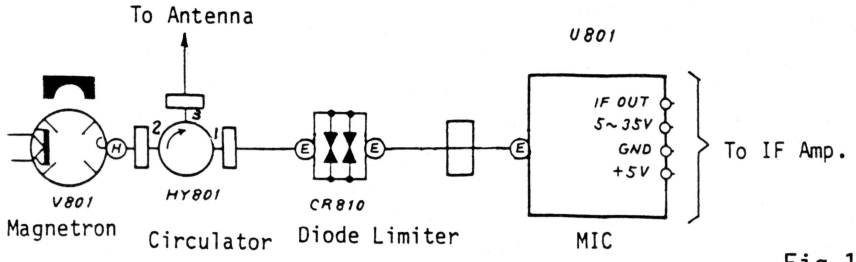


Fig.1-15

The circulator HY801 is a passive directional coupler with three ports. It contains a permanent magnet and a core of ferrite material and bends the electromagnetic wave in a specific direction. In Fig.1-15, the microwave energy produced by the magnetron enters the circulator from port 2. It is bent in the specific direction and emerges from port 3 with little loss, port 1 being isolated. In the same manner, the received signal entering into port 3 is transferred to port 1, isolating port 2. This operation of the circulator protects the receiver during transmission and minimizes loss of the received signal during reception.

The diode limiter CR810 is a self-activating switch made up of a PIN diode and a varactor diode. Its function is to attenuate the strong transmission signal of other boat radars that may enter from the antenna and to protect the MIC (Microwave IC). The PIN diode has a particular characteristic as in Fig.1-16 and conducts at a certain level of microwave power. When the diode is in the cut-off state, the input impedance of the diode limiter matches the characteristic impedance of the waveguide, and the microwave energy is delivered to the MIC. When the diode is put into a conductive state, the waveguide is shortcircuited and most of the input energy is reflected back to the transmitter side. The strong signal thus attenuated is further weakened down to about 150mW by a varactor diode.

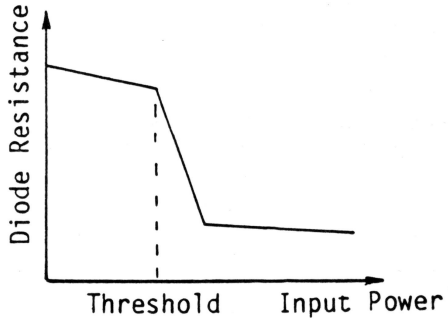


Fig.1-16

U801 is a MIC incorporating a local oscillator and mixer diodes. The received microwave signal of 9410MHz coming from the diode limiter is mixed with the local oscillation signal in the mixer diodes and converted to IF signal of 60MHz.

STC Circuit

The STC circuit made up of U603, Q606 and Q607 changes the gain of the IF amplifier with respect to time so that the gain is minimum at the time of transmission and increases gradually to maximum gain.

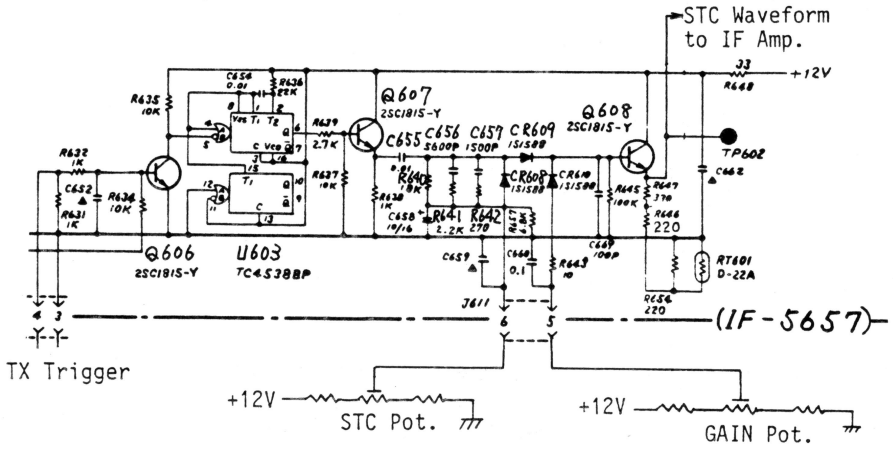


Fig.1-17 STC Circuit

Input to the STC circuit is the TX trigger pulse derived from the display unit. One-shot multivibrator U603 is triggered by the leading edge of the TX trigger pulse and produces a pulse of 240us, driving Q607 into conduction. The positive going pulse at the emitter of Q607 is differentiated by C655 and R640; the negative spike of the resultant waveform is removed by CR608.

The CR network consisting of C656/R641 and C657/R642 is an integrator, each couple having a specific time constant. The network compensates for the differentiator output waveform so that the slower decrease curve may result at the anode of CR609. The **STC** control on the front panel slices the compensated waveform at the part below the anode voltage of CR608. Q608 amplifies the resultant waveform and supplies its output to the IF amplifier to suppress the gain. The gain reduction in the IF amplifier is proportional to the amplitude of the waveform, that is, the gain is minimum at the time of transmission and gradually restores to the level set by the **GAIN** control on the front panel.

How the STC waveform changes with the **STC** control setting is shown below. The **GAIN** control changes the base potential of Q608, emitter current of Q608 and accordingly the IF amplifier gain.

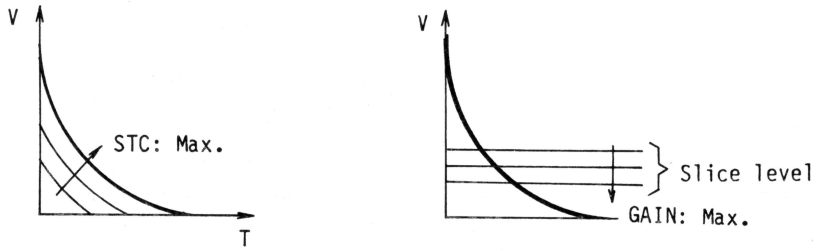


Fig.1-18 STC Waveform at TP602

IF Amplifier

See Fig.1-19. The IF signal of 60MHz coming from the MIC is amplified and converted into video signal, which is delivered to the display unit.

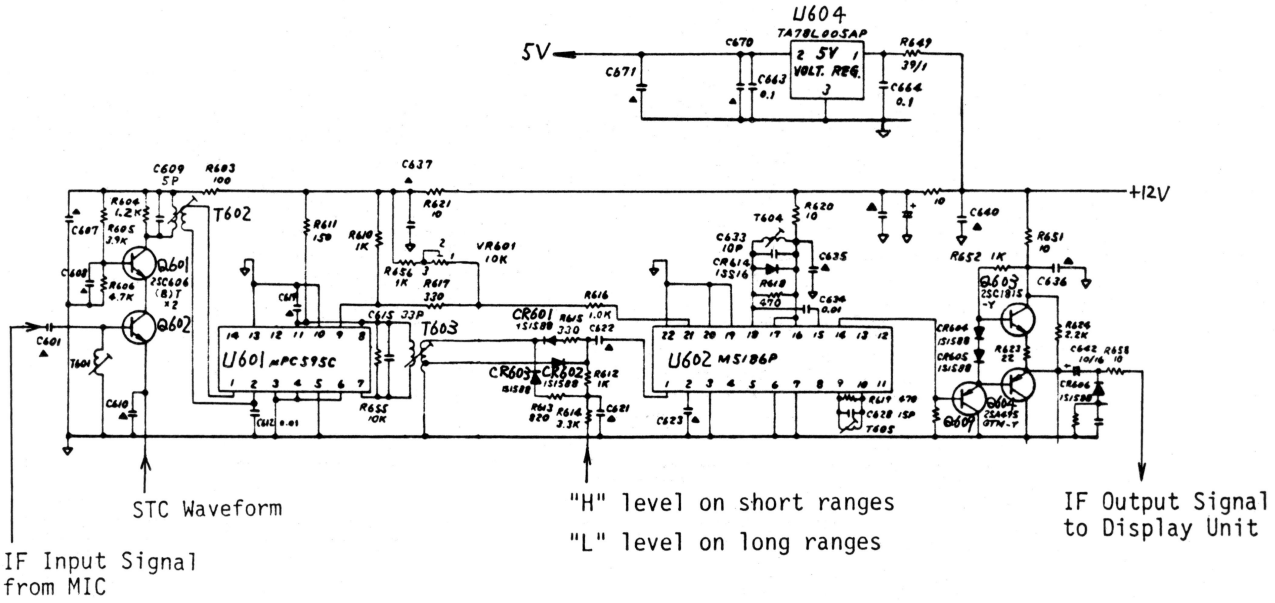


Fig.1-19 IF Amplifier

The IF amplifier is composed of four major circuits; Linear Amplifier (Q601/Q602, U601), Video Amplifier (Q603/Q604/Q609), Bandpass Selector (T603, CR601/CR602/CR603) and Voltage Regulator (U604).

A signal applied to the base of Q602 is amplified by Q601 and Q602 in cascade, and sent to U601 via T602. Then, the signal is amplified further by U601 and detected by U602. The detected signal is amplified by Q603/Q604/Q609 and delivered to the display unit as a video signal.

The IF amplifier operates in either a narrow or a wide bandwidth mode depending on the setting of the **RANGE** switch. For short ranges, the impedance at the secondary winding of T603 decreases since CR601/CR603 are conductive and CR602 is cut off, resulting in selection of a wide bandwidth (7MHz). On the contrary, CR601/CR603 are off and CR602 is on, selecting a narrow bandwidth (3MHz) on long ranges.

U604 produces the +5V regulated voltage for the MIC.

Motor Control Circuit (SI-5588)

The motor control circuit consists of a bearing signal generator and a motor controller as shown in Fig.1-20.

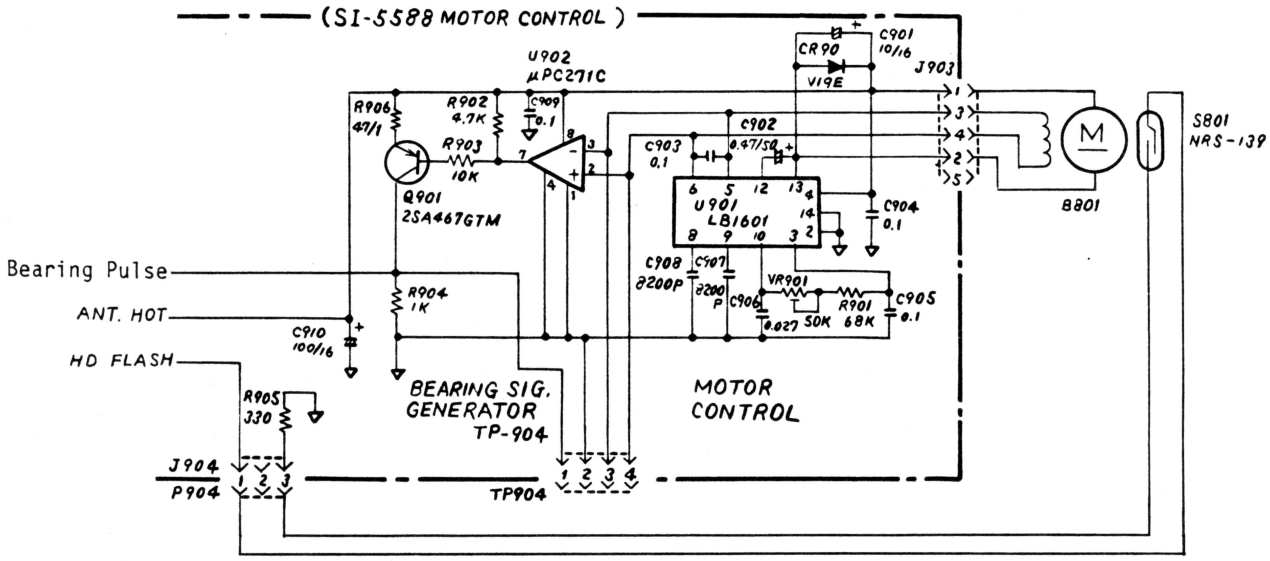


Fig.1-20

The bearing signal generator senses the antenna speed by means of a tacho-meter incorporated in the scanner motor. The tacho-meter output signal (180Hz) is amplified through U902 and Q901, and then sent to the display unit in order to perform the X-Y coordinate conversion in the CPU board.

The motor controller is composed of the motor control IC (U901) and some resistors and capacitors around U901. The tacho-meter output signal is sent to pins #5 and #6 of U901 so as to keep the motor speed constant. If the motor speed increases by some reasons, that is, the tacho-meter output frequency goes high, the voltage (motor cold line) at pin #13 of U901 increases as well, resulting in reduction of the motor speed.

CHAPTER 2 ADJUSTMENT

2.1 GENERAL

This chapter mainly describes radar adjustment in the workshop and the necessary check and adjustment at installation. Additionaly the following cases are described to aid you in setting up the radar onboard the ship.

(1) When a major component has been replaced.

(2) When it is considered that a fault is caused by improper adjustment or deviation of preset controls.

Table 2-1 Measuring Instruments (for servicing onboard)

No.	Name	Recommended Type	Specifications/Remarks
1	Multimeter	Sanwa YX-390TR	Vdc: 120mV to 1200V (20kohms/V) Vac: 6V to 1200V (9kohms/V) Idc: 50uA to 300mA R : 2kohms to 20Mohms
		Sanwa AX-303TR	Vdc: 0.3V to 1200V (20kohms/V) Vac: 6V to 1200V (8kohms/V) Idc: 60uA to 300mA & 12A R : 2kohms to 20Mohms
2	Digital Multimeter	Sanwa 430OTR	Vdc: 2V to 1000V Vac: 2V to 1000V Idc: 200mA R : 2kohms to 20Mohms
		Sanwa 7200ES	Vdc: 200mV to 1000V Vac: 200mV to 600V Idc: 0.2mA to 200mA Iac: 0.2mA to 200mA R : 0.2kohms to 20Mohms
3	Oscilloscope	TEKTRONIX 324	Vert: DC to 10MHz, Single Trace, 2mV/div to 20V/div, 500V max. Rise time 36ns Hor : 1us/div to 0.2s/div 0.2us/div min. with x5 sweep 0.5s/div max. with sweep adj. TRIG: Auto/manual, Int/Ext. CRT : 6x10 div (38mmx63.5mm)

Table 2-2 Measuring Instruments (for servicing in workshop)

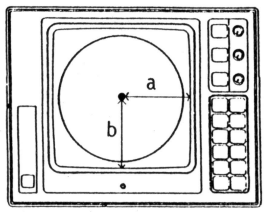
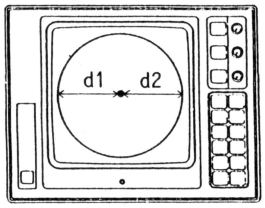
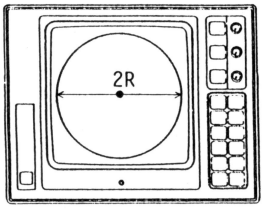
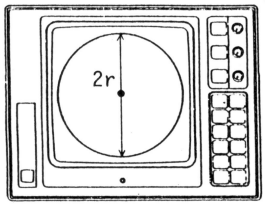
No.	Name	Recommended Type	Specifications/Remarks
1	Multimeter	See Table 2-1.	
2	Digital Multimeter		
3	Oscilloscope	TEKTRONIX 324	See Table 2-1.
		TEKTRONIX 455	Vert: DC to 50MHz, Dual Trace, 5mV/div to 50V/div, Hor : 0.05us/div to 0.5s/div 5ns/div min. with x10 sweep TRIG: Auto/manual, Int/Ext. CRT : 8x10 div (80mmx100mm)
4	Variable-Voltage DC Power Supply		Output Voltage: 0 to 60VDC
5	Frequency Counter	Takeda Riken TR-5104	Freq. : DC to 60MHz Vin : 50mV to 5V Period : 1us to 1000s
		Iwatsu UC-7641	Freq. : DC to 60MHz Vin : 10mV to 20V Period : 0.1us to 10,000S

Table 2-3 Adjusting Points and Ratings

No.	Item	Rating	Adjuster	Check Point	Refer to
1	Transmission Timing	Straight object should be displayed straight.	ADJ-6175 PCB VR3	CRT Screen	Page 2-6
2	Heading Alignment	Bearing of target echo on the screen should be the same as that on navigational chart or the same when visually measured.	Heading flash key S801 in the scanner unit	CRT Screen	Page 2-7
3	Tuning	Weak long range echo should be discerned with maximum sensitivity.	ADJ-6175 PCB VR2	CRT Screen	Page 2-8
4	Main-inv. Output Voltage	11.7 to 11.9VDC	PTU-6171 PCB VR1	PTU-6171 PCB P1302#1(+) #3(-)	Page 2-9
	Each Line Voltage		Confirmation only		
	+31V Line	29.0 to 33.0VDC		J1#7(+) #2(GND)	
	+5V Line	4.75 to 5.25VDC		J1#4(+) #2(GND)	
	Heater +7V	6.5 to.7.5VDC		J2#3(+) J1#2(GND)	
	TX-HV +300V	290 to 300VDC		J3#1(+) J1#2(GND)	
	Main-inv. Osc. Freq.	85.5 to 94.5kHz		TP301#5 #6	
	Sub-inv. Osc. Freq.	42.75 to 47.25kHz		Q1-Drain TP2	
5	Gain Preset	**GAIN** Control: Fully CW	ADJ-6175 PCB VR1	VOL-6174 Tap#7(+) Chassis(-)	Page 2-11
		6.5 to 6.7VDC			

Continued

NOTE: Items 1 to 3 should be adjusted at installation.

No.	Item	Rating	Adjuster	Check Point	Refer to
6	Center Spot Position	 a = b = 71.5 to 73.5mm	MAGNET RINGS	CRT Screen	Page 2-13
	Horizontal Linearity	 d1 = d2	DEFLECTION PCB R53 (V-LIN)		
	Horizontal Width	 2R = 124 to 130mm	DEFLECTION PCB R49 (V-SIZE)		
	Vertical Width	 2r = 124 to 130mm	DEFLECTION PCB L3 (H-SIZE)		
	CRT Brilliance	Raster should not appear, and marks, characters and numerals appear on the CRT clearly.	DEFLECTION PCB R37 (BRIGHT)		
	CRT Contrast	Maximum contrast	DEFLECTION PCB R7 (CONTRAST)		
	Vertical Synchro-nization		DEFLECTION PCB L1 (H-HOLD)		

Continued

No.	Item	Rating	Adjuster	Check Point	Refer to
	Horizontal Synchro-nization		DEFLECTION board R56 (V-HOLD)	CRT Screen	
	Focus		DEFLECTION board R33 (FOCUS)		
7	Scanner Unit				
	Magnetron Current	Short: 1.3 to 2.4VDC Long: 1.8 to 2.4VDC	Confirmation only	P801 #3(+)-#5(-)	Page 2-18
	Magnetron Heater Volt.	6.0 to 6.6VDC	Confirmation only	T801 #4(+)-#6(-)	Page 2-19
	Motor Speed	178 to 182 Hz	VR901	TP904 #3 & #4	Page 2-20

2.2 Adjustment at Installation

The following adjustments should be made at installation.

1. Transmission Timing
2. Heading Alignment
3. Tuning

Adjustment of Transmission Timing

Transmission timing differs with respect to the length of the multicore cable between the display and the scanner units. This adjustment must be performed at installation without fail, otherwise the following symptoms will appear. See Fig.2-1.

* Straight quay or breakwater appears bent inward or outward near the center spot on 0.25 n.m. range.

* Range error is found on short range.

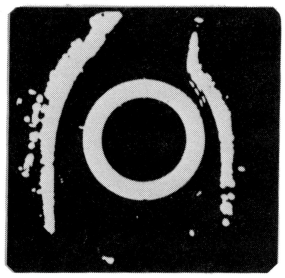
* Wide ring appears at the screen center.

In order to reject the above symptoms, the adjustment is made with VR3 on the PRESET CONTROLS board (ADJ-6175) while observing a proper target echo on the screen. See Fig.2-1.

R Photo No. 422

a. PROPER SETTING
Straight target appears as a straight line on the screen.

b. TURN VR3 CW TO CORRECT.
Straight target appears bent inward at the screen center.



c. TURN VR3 CCW TO CORRECT.
Straight target appears bent outward at the screen center.

Fig.2-1 Sweep Timing Adjustment

Heading Alignment

Procedure:

1) Identify a suitable target (e.g. buoy or end of quay) at a range between 1/8 to 1/4 miles, preferably located on or around the heading flash and near the edge of the screen.

2) Press the EBL key to bring up the EBL on the screen.

3) Press either of the arrow keys until the EBL cursor is directly over the center of target. Read the EBL bearing at the bottom left on the screen.

4) Find the relative bearing of the target from the ship's heading on the navigational chart by referring to the ship's compass. The relative bearing can also be obtained by visually measuring the direction of the target from the ship's bow using the dumb card.

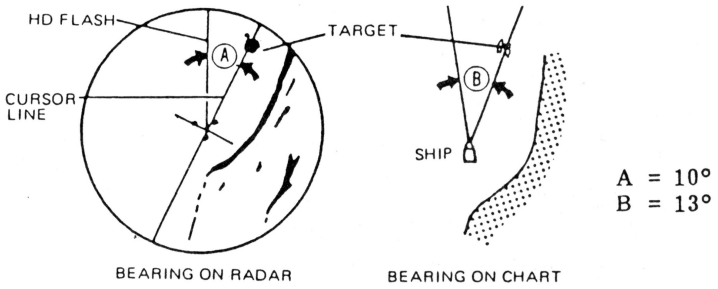


Fig.2-2 Relative Bearing Alignment
(When the relative bearing of the target measured on the radar screen (A) does not agree with that measured on the navigational chart (B).)

5) Remove the radome to obtain access to the transceiver module. Slightly loosen the two screws which secure the heading flash key at the port inside the radome. If the screws are loosened excessively fine adjustment will be more difficult.

6) There are vertical lines located below the heading flash key. The lines closer to the center mark (darker line) are each equivalent to a bearing error correction of approximately 1.5°. The lines further away from the center are slightly less than 1.5°.

   Adjust the heading flash key, moving it to the right-hand side (aft direction) or to the left-hand side (fore direction). For the example in Fig.2-2, move the heading flash key to the right-hand side by about 2 marks for a correction of 3° error to the starboard side.

7) After adjustment, tighten the heading flash key fixing screws securely.

8) Install the radome on the radome base assembly, being careful of its direction. The narrower recessed part should face the bow.

9) Tighten the radome fixing bolts securely.

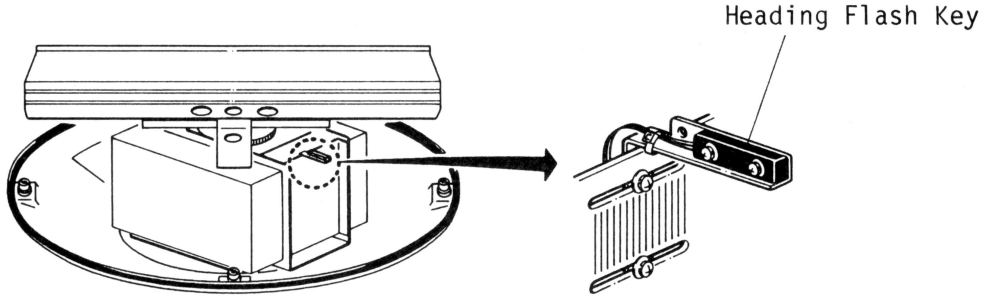


Fig.2-3 Location of Heading Flash Key

Tuning

Tuning adjustment is required if the best tuning condition is not obtained with the **TUNE** control on the front panel set around mid-travel.

Procedure:

1) Set the radar on one of the longer ranges and adjust the **GAIN & BRILLIANCE** controls to obtain normal picture on the screen.

2) Wait approx. 10 minutes to stabilize the oscillation of the magnetron.

3) Set the **TUNE** control around mid-travel.

4) Turn VR2 (tune preset pot.) on the PRESET CONTROLS board (ADJ-6175) fully CW and turn it CCW gradually to detect the tuning point where a weak long range echo is discerned with maximum sensitivity. See Fig.2-4.

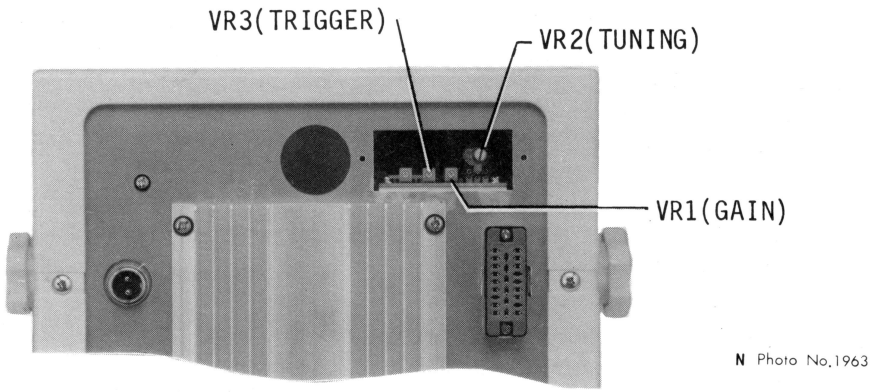


Fig.2-4 PRESET CONTROLS

2.3 Inverter

The following adjustments and confirmations are made on the POWER SUPPLY board (PTU-6171). See Fig.2-5.

Item	Rating	Adjuster	Check Point
Main-inverter Output Voltage	11.7 to 11.9VDC	VR1	P1302#1(+) & #3(-)
Each Line Voltage		Confirmation Only	
+31V Line	29.0 to 33.0VDC		J1#7(+) & #2(GND)
+5V Line	4.75 to 5.25VDC		J1#4(+) & #2(GND)
HEATER +7V	6.5 to 7.5VDC		J2#3(+) & #4(GND)
TX-HV +300V	290 to 310VDC		J3#1(+) & J1#2(GND)
Main-inverter Oscillation Frequency	85.5 to 94.5kHz (10.6 to 11.7uS)		TP301#5 & #6
Sub-inverter Oscillation Frequency	42.75 to 47.25kHz (21.2 to 23.4uS)		Q1-DRAIN & TP2

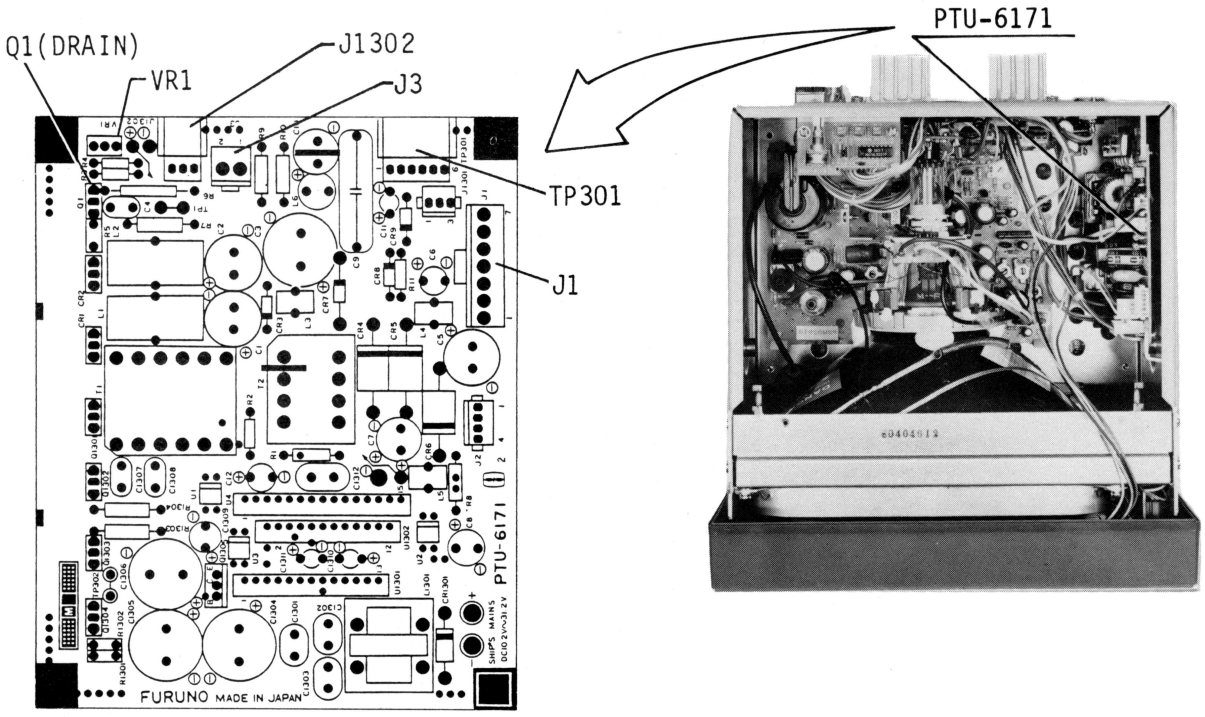


Fig.2-5 POWER SUPPLY board (PTU-6171)

Necessary Test Instruments:

1) Digital Multimeter
2) Frequency counter or well-calibrated oscilloscope

Condition: Standby, 0.25 n.m. range, normal CRT brilliance.

Procedure:

1) Operate the radar in the above condition with the rated power supply voltage. (Power supply voltage can be measured between solder side of J1351#1(+) and #2(-).)

2) Connect a digital multimeter, set to 30VDC range, between P1302-#1(+) and #3(-).

3) Adjust VR1 for 11.8VDC on the digital multimeter. (Main-inverter Output Voltage Adj.)

4) Then, confirm each line voltage (+31V line, +5V line, HEATER, TX-HV) at the check points listed above. (Each Line's Voltage Adj.)

5) Connect a frequency counter or well-calibrated oscilloscope between TP301#5 and #6, and confirm the oscillation frequency (85.5 to 94.5kHz) of the main-inverter. (10.6 to 11.7uS in period when measured by an oscilloscope.) (Main-inverter Oscillation Frequency Check)

6) Connect the frequency counter or well-calibrated oscilloscope between Q1-DRAIN and TP2, and confirm the oscillation frequency (42.75 to 47.25kHz) of the sub-inverter. (21.2 to 23.4uS in period when measured by an oscilloscope.) (Sub-inverter Oscillation Frequency Check)

* If each line voltage and/or sub-inverter oscillation frequency are out of ratings, U4 and/or Q1 on the PTU-6171 board may be faulty.

2.4 Gain Preset Voltages

These adjustments are made on the PRESET CONTROLS board (ADJ-6175) and VOLUME board (VOL-6174). See Fig.2-6.

Item	Rating	Adjuster	Check Point
Gain Preset	6.5 to 6.7V with GAIN control fully CW.	ADJ-6175 board VR1 (GAIN)	VOL-6174 TAP#7(+) CHASSIS(-)

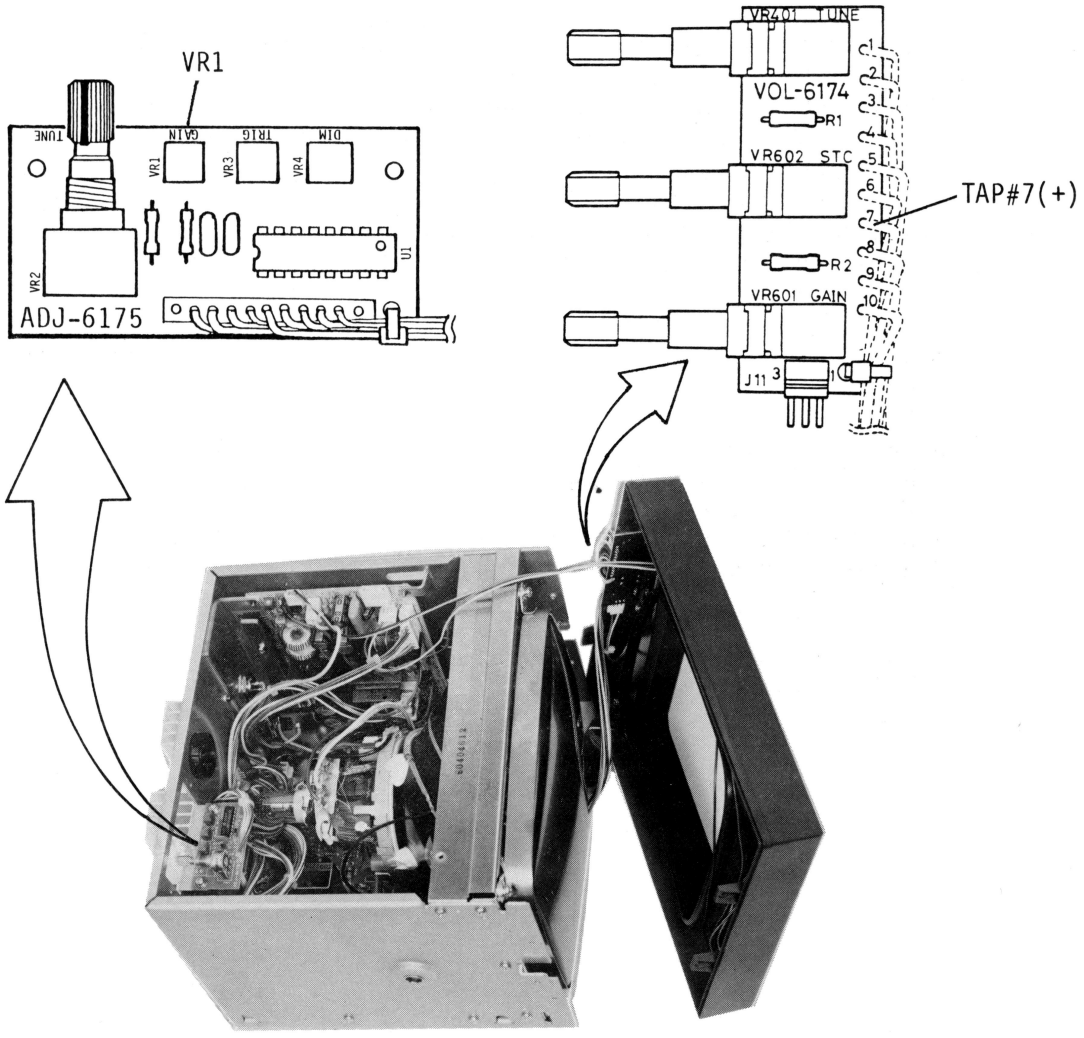


Fig.2-6 PRESET CONTROLS board (ADJ-6175) and VOLUME board (VOL-6174)

Necessary Test Instrument: Digital Multimeter

Condition: Transmission; Maximum range; STC, CCW (minimum); FTC, OFF; IR, OFF; GAIN, CW (maximum)

Procedure:

1) Loose the 4 fixing screws of the front panel and free the front panel from the chassis.

2) Connect a digital multimeter, set to 10VDC range, between TAP#7(+) and chassis(-) on VOL-6174 board.

3) Operate the radar in the above condition.

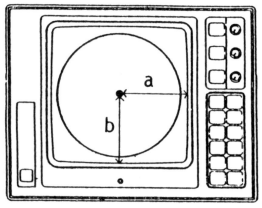
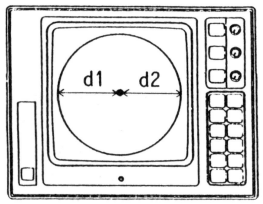
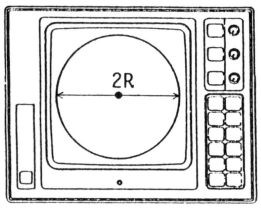
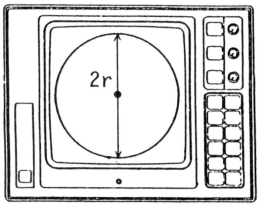
4) Adjust VR1 for 6.6VDC on the digital multimeter.

5) Turn the **GAIN** knob on the front panel between the 3 and 5 o'clock position and confirm that a small amount of background noise appears on the screen.

6) Press the IR key and confirm that the background noise fades from the screen.

2.5 Deflection Circuit

The following adjustments are made on the DEFLECTION board.
See Fig.2-7.

Item	Rating	Adjuster	Check Point
Center Spot Position	 a = b = 71.5 to 73.5mm	MAGNET RINGS	CRT Screen
Horizontal Linearity	 d1 = d2	DEFLECTION PCB R53 (V-LIN)	
Horizontal Width	 2R = 124 to 130mm	DEFLECTION PCB R49 (V-SIZE)	
Vertical Width	 2r = 124 to 130mm	DEFLECTION PCB L3 (H-SIZE)	
CRT Brilliance	Raster should not appear, and marks, characters and numerals appear on the CRT clealy.	DEFLECTION PCB R37 (BRIGHT)	
CRT Contrast	Maximum contrast	DEFLECTION PCB R7 (CONTRAST)	

Continued

Item	Rating	Adjuster	Check Point
Vertical Synchronization		DEFLECTION PCB L1 (H-HOLD)	CRT Screen
Horizontal Synchronization		DEFLECTION board R56 (V-HOLD)	
Focus		DEFLECTION board R33 (FOCUS)	

NOTE: Since the deflection coil is fixed 90 degrees from normal, "V" and "H" indications on the DEFLECTION board correspond to "Horizontal" and "Vertical" respectively.

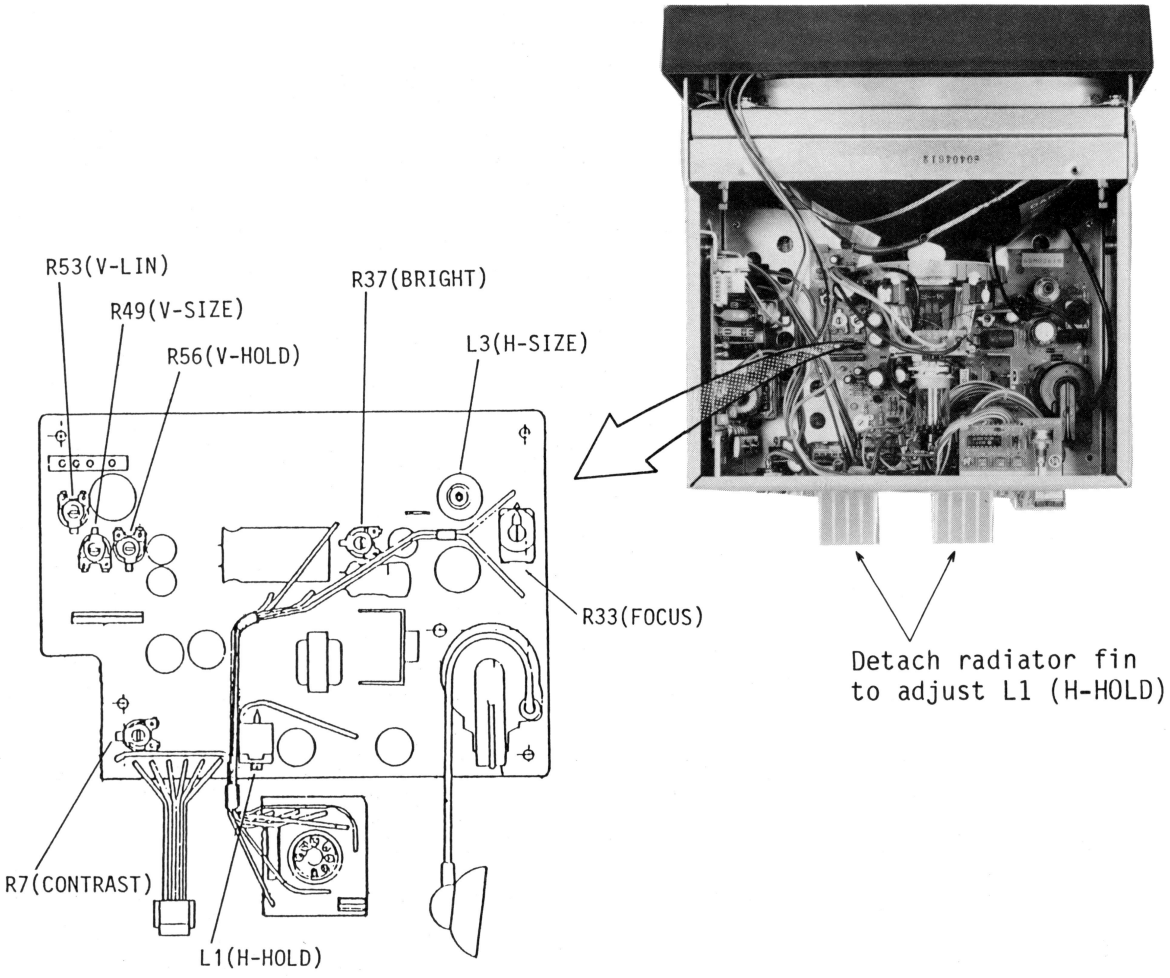


Fig.2-7 DEFLECTION board

Necessary Test Instrument: Paper pattern (See Fig.2-11), Plastic hex. wrench (2.6mm distance between ends)

Condition: Transmission, Maximum range, Proper BRILLIANCE, RING: ON

Procedure:

1) Using tracing paper, copy or draw the pattern show in Fig.2-11.

2) Operate the radar in the above condition, and then turn GAIN knob to CCW (minimum).

3) Attach the paper to the screen with stick tape. (See Fig.2-8)

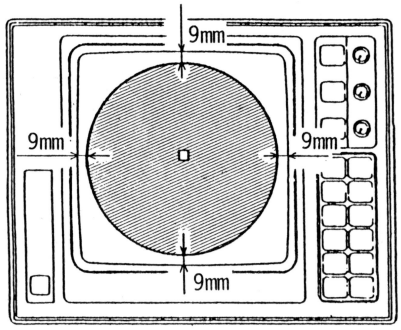


Fig.2-8

4) Confirm that the center spot is positioned over the center hole of the paper pattern. If not, adjust two magnet rings of the CRT tube. (Center Position Adj.)

5) Turn GAIN knob CW so that the back-ground noise just fades from the screen and then set the CRT brilliance to maximum.

6) Confirm that the lengths of d1 and d2 are nearly equal. If not, adjust R56 (V-LIN). (Horizontal Linearity Adj.)

7) Confirm that the both arrow marks at 90° and 270° just come into contact with the outer edge of the paper pattern. If not, adjust R49 (V-SIZE). (Horizontal Width Adj.)

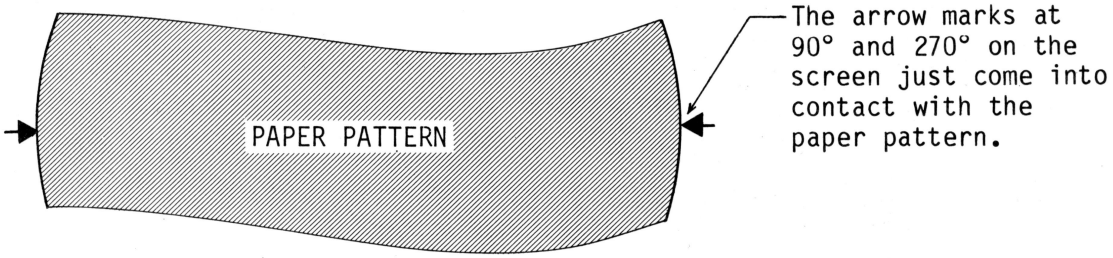


Fig.2-9 Horizontal width adjustment

8) Confirm that the both arrow marks at 0° and 180° just come into contact with the outer edge of the paper pattern. If not, adjust L3 (H-SIZE). (Vertical Width Adj.)

Note: Because the core of L3 (H-SIZE) is chipped easily, use a plastic hex. wrench (2.6mm distans between ends) to make adjustments. Never use an iron hex. wrench or a wrong size plastic hex. wrench to make the adjustment.

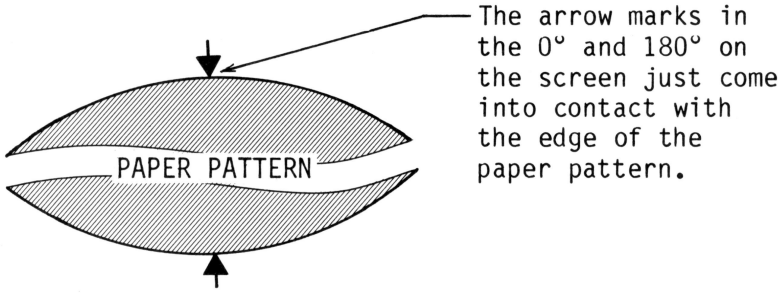


Fig.2-10 Vertical width adjustment

9) Depress the BRIL button so as to get maximum brilliance of the screen.

10) With the viewing hood attached, adjust R37 (BRIGHT) so that the raster just fades from the screen. (CRT Brilliance Adj.)

11) Confirm that R7 (CONTRAST) is set fully CCW. (CRT Contrast Adj.)

12) Depress BRIL button to obtain proper brilliance.

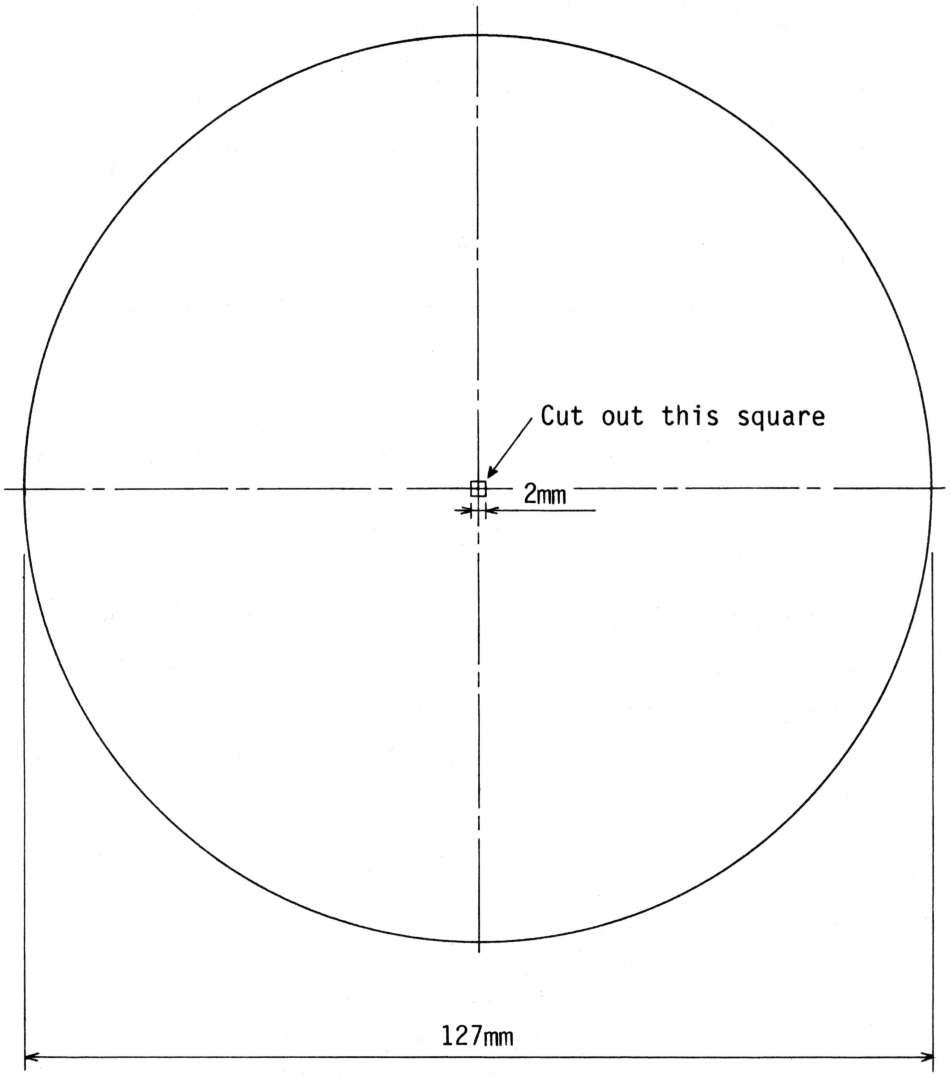
13) Detach the radiator fin of the display unit by loosening the 6 fixing screws.

14) Adjust L1 (H-HOLD) for vertical synchronization. (Vertical Synchronization Adj.)

15) Replace the radiator fin as it was.

16) Adjust R56 (V-HOLD) for horizontal synchronization. (Horizontal Synchronization Adj.)

17) Adjust R33 (FOCUS) so that the picture is focused. (Focus Adj.)



* COPY OR DRAW ON TRACING PAPER

Fig.2-11 Paper Pattern (Actual size)

2.6 Adjustment and Confirmation for Scanner Unit

Magnetron Current (Confirmation only)

Rating	Check Point
Short: 1.3 to 2.4VDC Long: 1.8 to 2.4VDC	P801 #3(+) - #5(-)

Necessary Test Instrument: Multimeter

Condition: Transmission, antenna rotation suspended, minimum CRT brilliance.

Procedure:

1) Connect a multimeter, set to 10VDC range, between P801 #3(+) and #5(-). See Fig.2-12.

2) Transmit the radar on a short range.

3) Confirm that the magnetron current is between 1.3 and 2.4V.

4) Set the **RANGE** switch to a long range and confirm that the magnetron current is between 1.8 and 2.4V.

If the current is far out of the range specified above, the magnetron may be faulty.

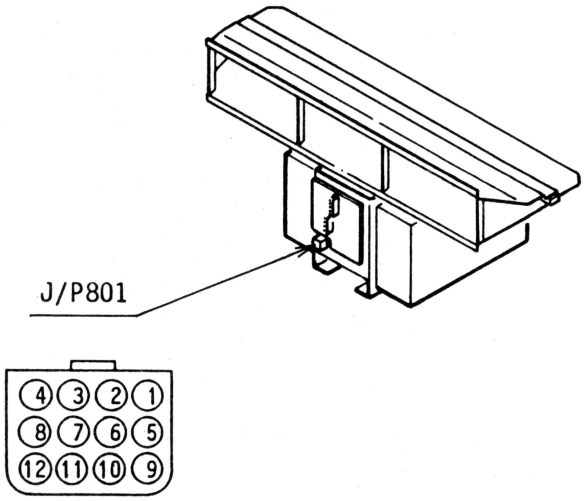


Fig.2-12 Scanner Unit

Magnetron Heater Voltage (Confirmation only)

Rating	Check Point
6.0 to 6.6VDC	T801 #4(+) - #6(-)

Necessary Test Instrument: Multimeter

Procedure:

1) Connect a multimeter, set to 10VDC range, between terminals #4(+) and #6(-) of the pulse transformer T801. See Fig.2-13.

2) Operate the radar in standby, 0.25 n.m. range, scanner rotation suspended and minimum CRT brilliance.

3) Confirm that the voltage is between 6.0 and 6.6VDC.

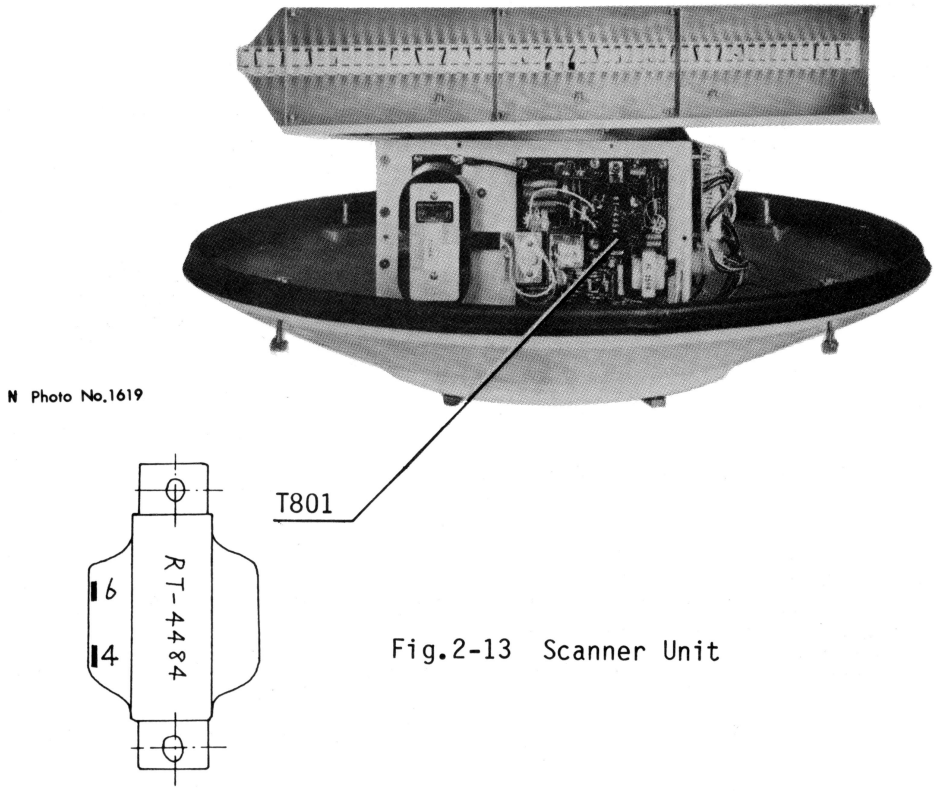


Fig.2-13 Scanner Unit

Motor Speed (Bearing Signal Frequency)

Rating	Adjuster	Check Point
178 to 182 Hz	VR901	TP904 #3 & #4

Necessary Test Instrument: Frequency Counter/Oscilloscope

Condition: Standby, 0.25 n.m. range, antenna radiator rotating.

Procedure:

1) Connect the probe of the frequency counter between TP904 #3 and #4. See Fig.2-14.

2) Operate the radar in the above condition.

3) Adjust VR901 on the MOTOR CONTROL board (SI-5588) so that the frequency counter indicates 180 Hz. See Fig.2-14.

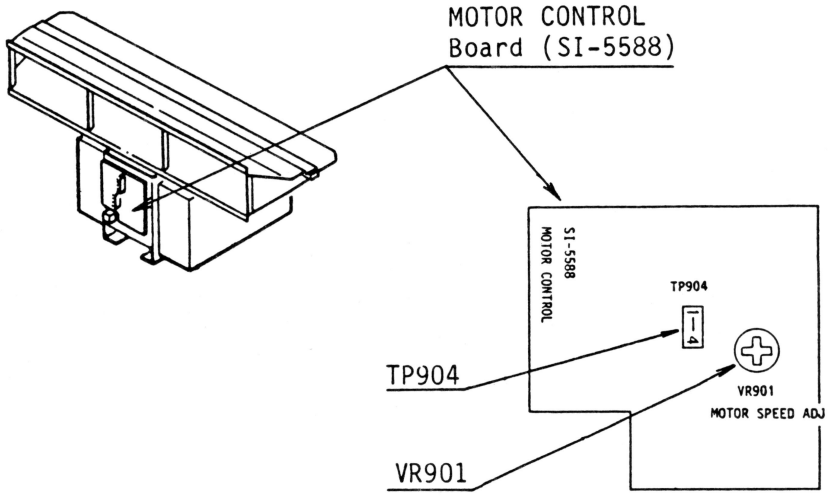
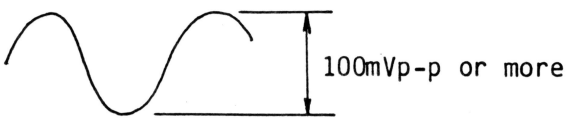


Fig.2-14 Scanner Unit

NOTE: Using an oscilloscope, confirm that the waveform between TP904 #3 and #4 (Fig.2-14) is as shown below.



SIN Waveform

CHAPTER 3 MAINTENANCE

3.1 General

The radar system should maintain optimum performance for a reasonably long period of time. Factory adjustment or alignment of circuits does not require frequent readjustments and realignments. However, continued performance can not be expected without periodic inspection and maintenance.

Periodically, a thorough inspection of the equipment should be made. Cable connections at terminal boards and connectors should be kept clean and tight. Be sure all ground connections are secure and properly grounded. Arrange all wires and cables in orderly manner to prevent the possibility of arc-over or short. Replace all wires that show signs of corrosion, cracking or deterioration.

All units of the equipment should be kept clean and free from corrosion. Replace all missing knobs and defective or broken parts. Housing, shields, covers and other protective devices should be at their proper place and secured.

3.2 Cleaning and Lubrication

Cleaning lengthens the operating life of the equipment. Dirt on components can result in shortcircuits. A dry, soft cloth and soft bristled brush are recommended for removing dirt from the outside of the unit. Dirt on the inside of the unit should be removed with a soft-bristled brush and removed by using an electric cleaner.

Hardened dirt should be removed by using a mild detergent and water solution on a cotton-tipped swab or a soft cloth. Avoid excessive use of water. Do not allow water to penetrate any parts. Avoid the use of abrasives and chemical agents.

Corroded areas should be cleaned with a neutralizing solution of 2% borax and water to prevent further corrosion.

CAUTION:

After cleaning, the sets should be carefully inspected for defects such as poor connections, damaged parts and loosened mechanical parts.

Keep all moving parts properly lubricated using a cleaning-type lubricant on shaft bushings. Do not overlubricate.

Before maintenance work, be sure to switch off the radar at main switchboard. When checking inside the units, wait for a few minutes until the high voltage components (CRT or HV capacitors) can discharge the residual charge.

Interval	Item	Check/Measures	Remarks
3 to 6 months	Radome	Check for dirt or crack on the radome surface. Thick dirt should be wiped off by using wet soft cloth or alcohol. If any crack is found, apply slight amount of sealing compound or adhesive as first-aid treatment, then call for repair.	*Do NOT use plastic solvent (thinners or acetone) for cleaning.
		Check the rubber packing for deterioration and replace it if necessary. (See Fig.3-1.)	*Deterioration of the rubber packing leads to permanent damage of the internal circuitry due to water immersion. It should be replaced at its earlier stage of deterioration.
	Exposed bolts and nuts	Check for corroded or loosened bolts/nuts. If necessary, clean them and repaint thickly. Replace them with new ones if heavily corroded.	*Sealing compound may be used instead of paint. *Put slight amount of grease if bolts and nuts are replaced.
	CRT screen	Dirt on the screen creates symptoms identical to poor sensitivity. Clean the CRT surface using special care not to scratch it.	*Use a soft cloth with a slight amount of anti-static-charge spray. Never apply plastic solvent.

Continued

Interval	Item	Check/Measures	Remarks
6 months to 1 year	CRT anode and approach (See Fig.3-2.)	High tension on CRT attracts dust, and moist dust will cause poor insulation. Clean high voltage parts as follows. 1. Turn off radar. 2. Pull out anode cap and touch its nipple to chassis (discharging). 3. Clean CRT side and anode cap/lead by using a soft dry cloth.	*If any crack is found on rubber cap or wire sheath, replace the damaged parts with a new one. *Always make sure that the anode cap is put back on the CRT after cleaning.
	Connectors, plugs and terminal boards	Check for loose connections. Clean contacts or replace plug, if necessary.	

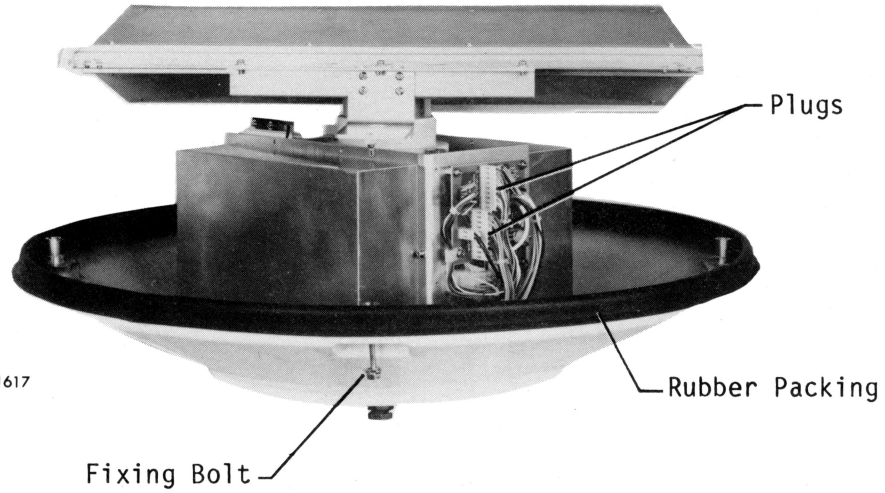


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Fig.3-1 Scanner Unit

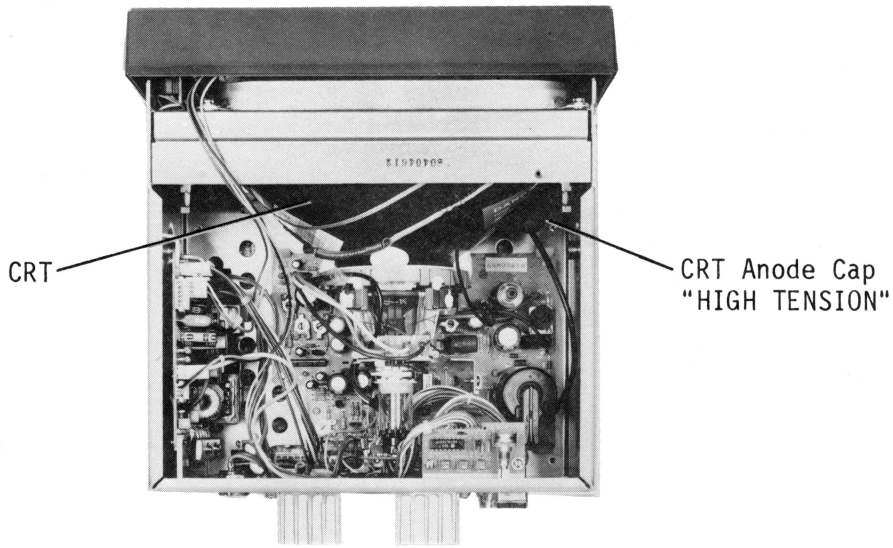

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Fig.3-2 Display Unit Top View

3.3 Removal and Replacement of Major Components in Display Unit

For the preparation, remove the display unit from the bracket by undoing the two bracket knobs and take off the display unit cover by loosening the four M4x10 screws at both sides.

Then, use the following steps referring to "Exposed View of Display Unit" on page D-1.

Power Supply Module

1) Loosen the four M3x8 screws and disconnect all plugs on the power supply board.

Front Panel Assembly

1) Remove the PROCESSOR board (SPU-6172).

2) Remove the three (GAIN, TUNE and STC) knobs on the control panel.

3) Detach the front panel assembly from the display chassis by loosening the four M3x8 screws.

Cathode Ray Tube

1) Remove the PROCESSOR board.

2) Detach the front panel assembly.

3) Disconnect the CRT socket and the grounding connector on the CRT DEFLECTION board.

4) Disconnect the CRT anode cap.

5) Loosen the four M4x10 screws securing the CRT.

3.4 Removal and Replacement of Major Components in Scanner Unit

Radiator Assembly A-170A

1) Loosen the four fixing bolts BT-101, and remove the radome upper assembly A-110A. See Fig.3-3.

2) Loosen the six M4x8 screws, and lift the radiator assembly A-170A up carefully. See Fig.3-4.

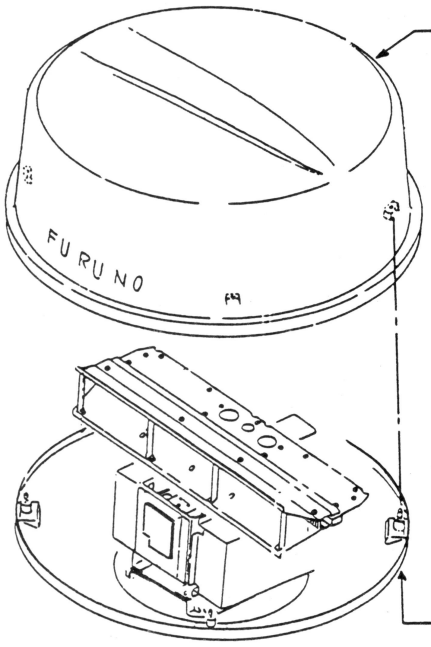


Fig.3-3

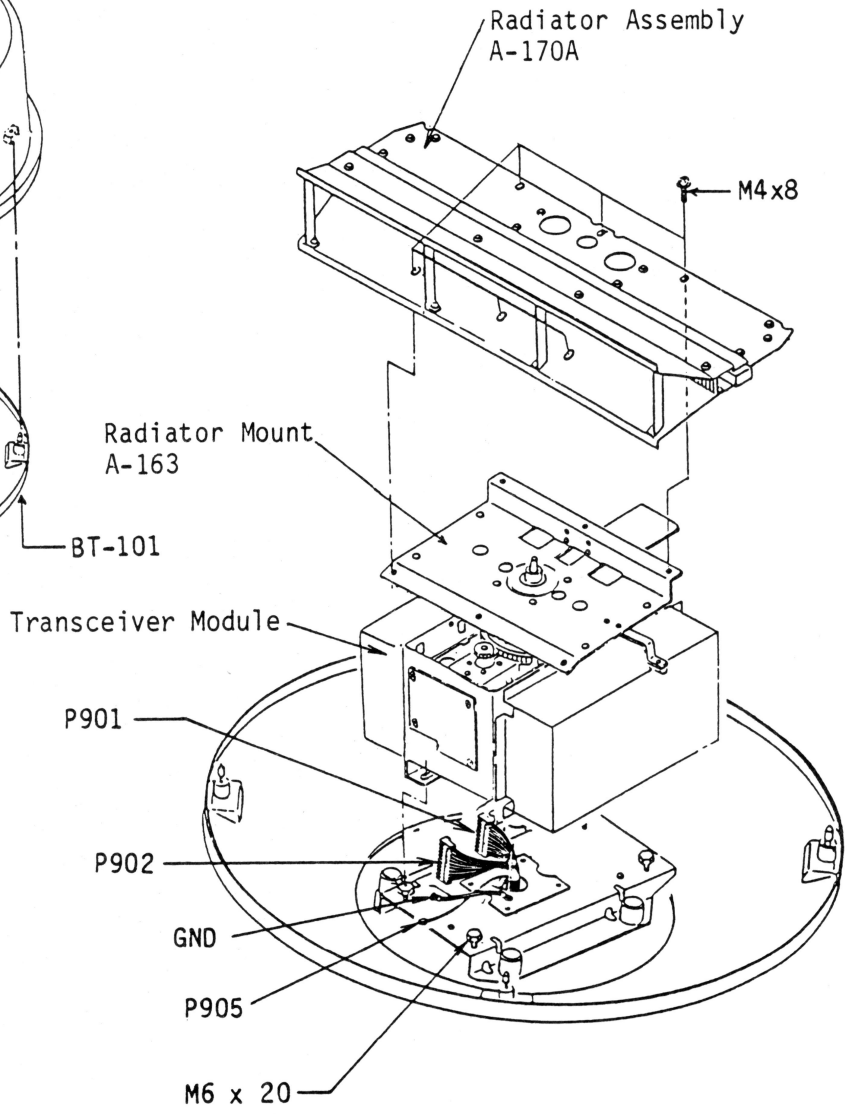


Fig.3-4

Scanner Motor B801

1) Loosen the four M6x16 hex. bolts and detach the scanner driving assembly.

2) Loosen the four M4x10 washer head screws and remove the motor fixing plate A-161 on which the scanner motor is mounted. See Fig.3-5.

3) Disconnect plug P903 on the MOTOR CONTROL board.

4) Loosen the four M3x8 washer head screws, and the scanner motor comes free.

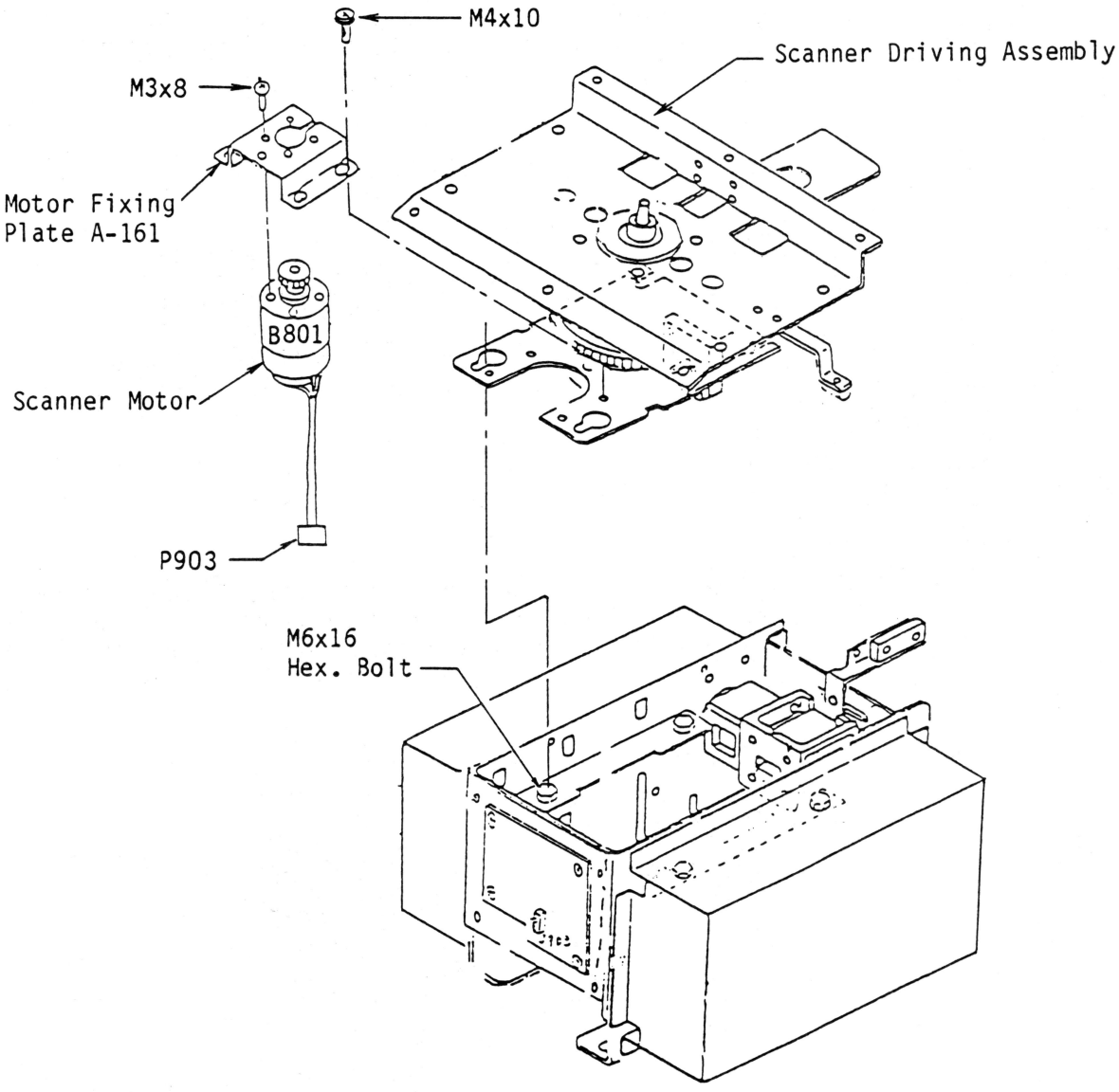


Fig.3-5

Transceiver Module

1) Remove the radome upper assembly. See Fig.3-3.

2) Disconnect plugs P901, P902 and P905, referring to Fig.3-4.

3) Loosen the four M6x20 hex. bolts and take out the transceiver module together with the radiator assembly. See Fig.3-4.

4) Loosen the four M6x16 hex. bolts, and detach the scanner driving assembly, referring to Fig.3-5.

Note: (1) When placing the transceiver module on a steel great care should be taken to avoid de-magnetization of the magnetron mounted on the module. See the figure below.

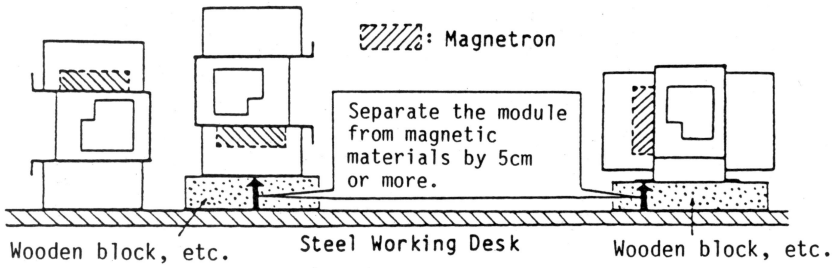

: Magnetron
Separate the module from magnetic materials by 5cm or more.
Wooden block, etc.
Steel Working Desk
Wooden block, etc.

Fig.3-6

(2) When remounting the scanner driving assembly to the transceiver module, take care that the two guide pins on the flange of the rotary joint are mated with the guide holes on the circulator.

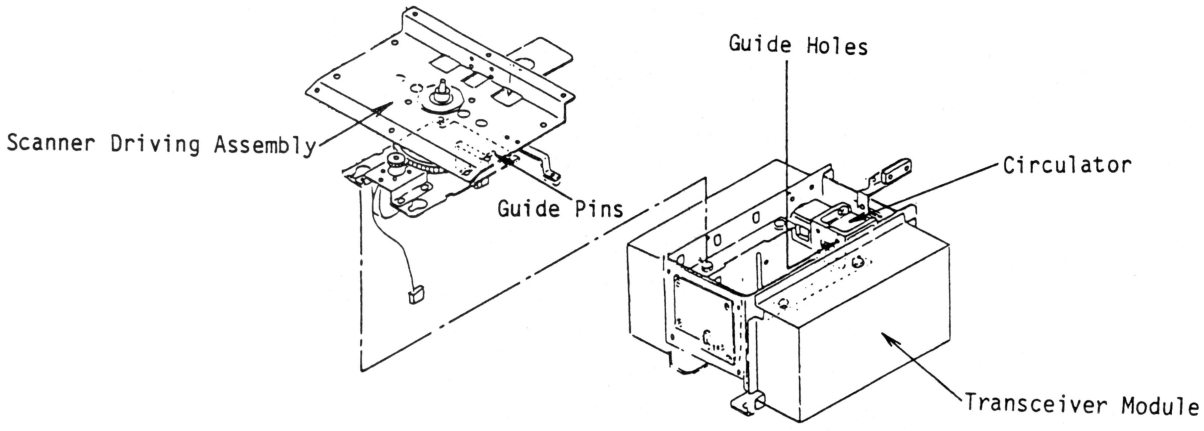


Fig.3-7

MODULATOR (MD-4171), IF AMPLIFIER (IF-5657) &
MOTOR CONTROL (SI-5588) Boards

The above p.c. boards are mounted on the transceiver module. The former two boards are covered with the shield cases A-185 and A-186. See Fig.3-8.

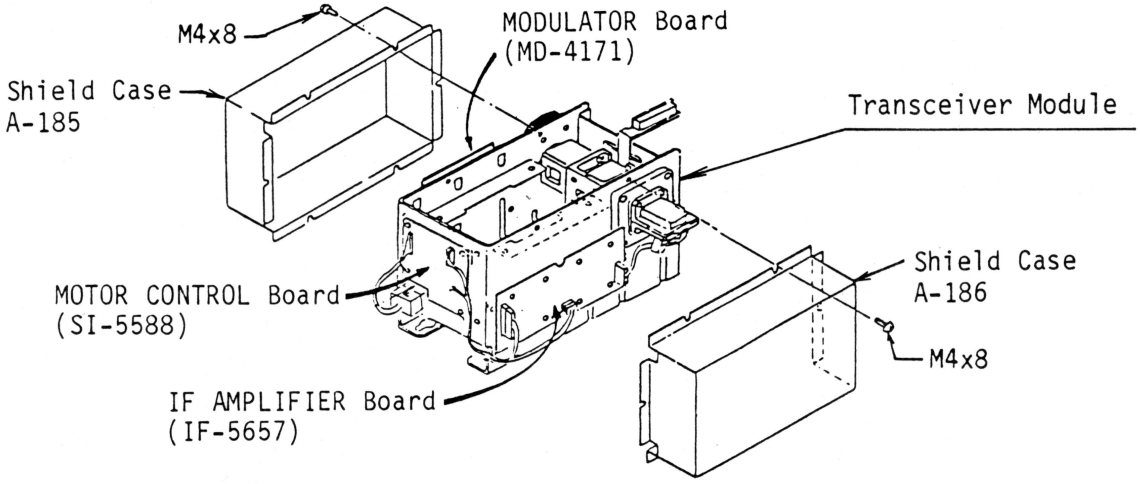


Fig.3-8

1) Take out the transceiver module by referring to page 3-8.

2) Remove respective shield cases A-185 and A-186, and the boards listed above are in sight.

3) Disconnect the plugs and loosen the screws fixing each board.

Magnetron V801

1) Make sure the radar system is turned off.

2) Take out the transceiver module by referring to page 3-8.

3) Remove shield case A-185. See Fig.3-8.

4) Unsolder the magnetron heater lead wires from the pulse transformer T801. See Fig.3-9.

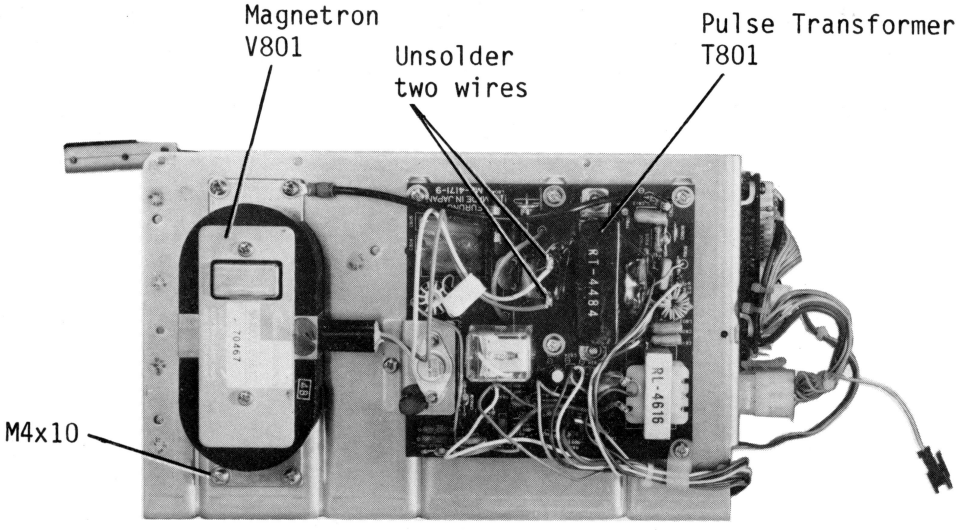
5) Before beginning this step, if you are wearing a watch, remove it; the strong magnetic fields generated by the magnetron may damage it. Then, loosen the four M4x10 washer head screws with a non-magnetic screwdriver, and carefully take out the magnetron.

Note; (1) Separate the magnetron from magnetic materials by 5cm or more. See Fig.3-6.

(2) The heater voltage must always be kept between 6.0 and 6.6VDC. Higher voltage shortens the life of the magnetron.

(3) When a new magnetron is fitted, allow at least 15 to 20 minutes pre-heating under ST-BY, and depress the TX touchpad about 10 times to prevent arcing.

(4) The magnetron must not be stored in the vicinity of ferro-magnetic materials and magnetic fields to prevent deterioration due to de-magnetization.



N Photo No.1878

Fig.3-9

Circulator HY801 & MIC U801 w/Limiter CR810

1) Take out the transceiver module by referring to page 3-8.

2) Remove shield case A-186. See Fig.3-8.

3) Disconnect plug P612 connected to the IF-5657 board, and loosen the four M4x25 washer head screws. See Fig.3-10.

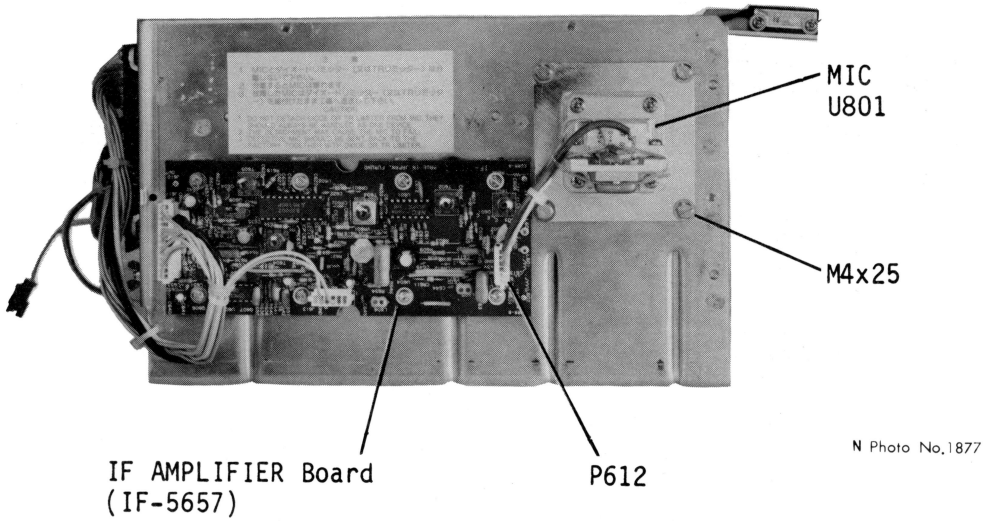


Fig.3-10

4) Carefully take out the assembly of the MIC (with limiter), circulator and adaptor A-182. Then, loosen the four M4x85 pan head screws, and the MIC (with limiter) and circulator comes free. See Fig.3-11.

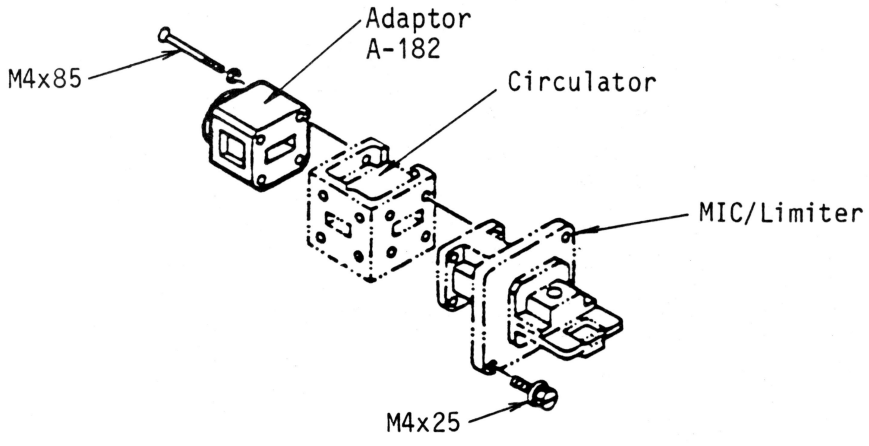


Fig.3-11

NOTE: 1. Do NOT separate the MIC from the limiter. They should always be handled as one device.

2. The defective MIC should be sent back to the factory together with the limiter.

3. After installing a new MIC, never fail to remove the bare wire which shortcircuits across the lead pins on the MIC. Do NOT energize the radar before removing the wire.

4. On replacement of the circulator, do NOT remove the piece of styrofoam inserted into a port of the circulator. As a magnet is used inside the circulator, metal filings are likely to be attached to it, and if these filings or dust come into the circulator, it causes poor sensitivity or deterioration of the magnetron.

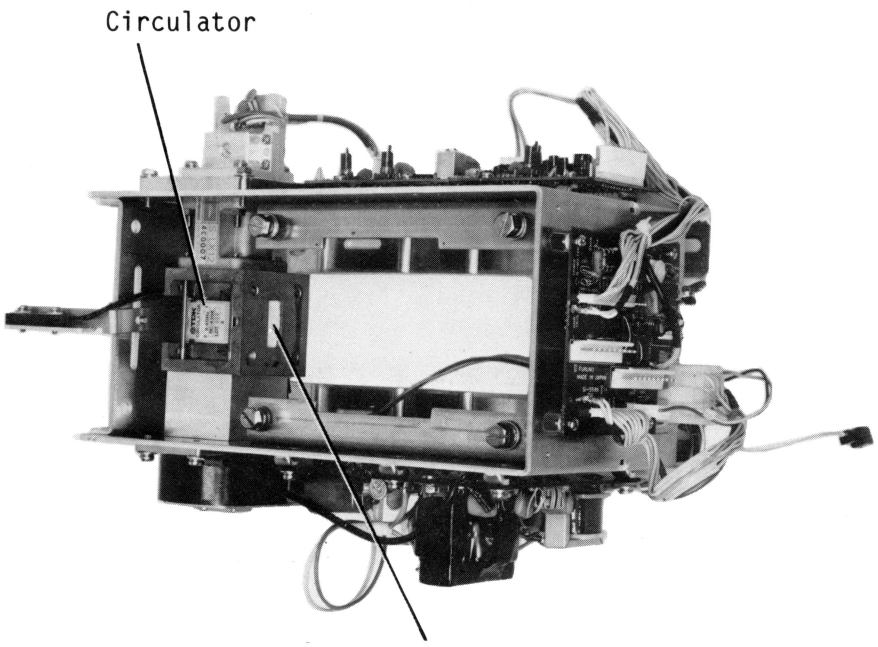


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Fig.3-12

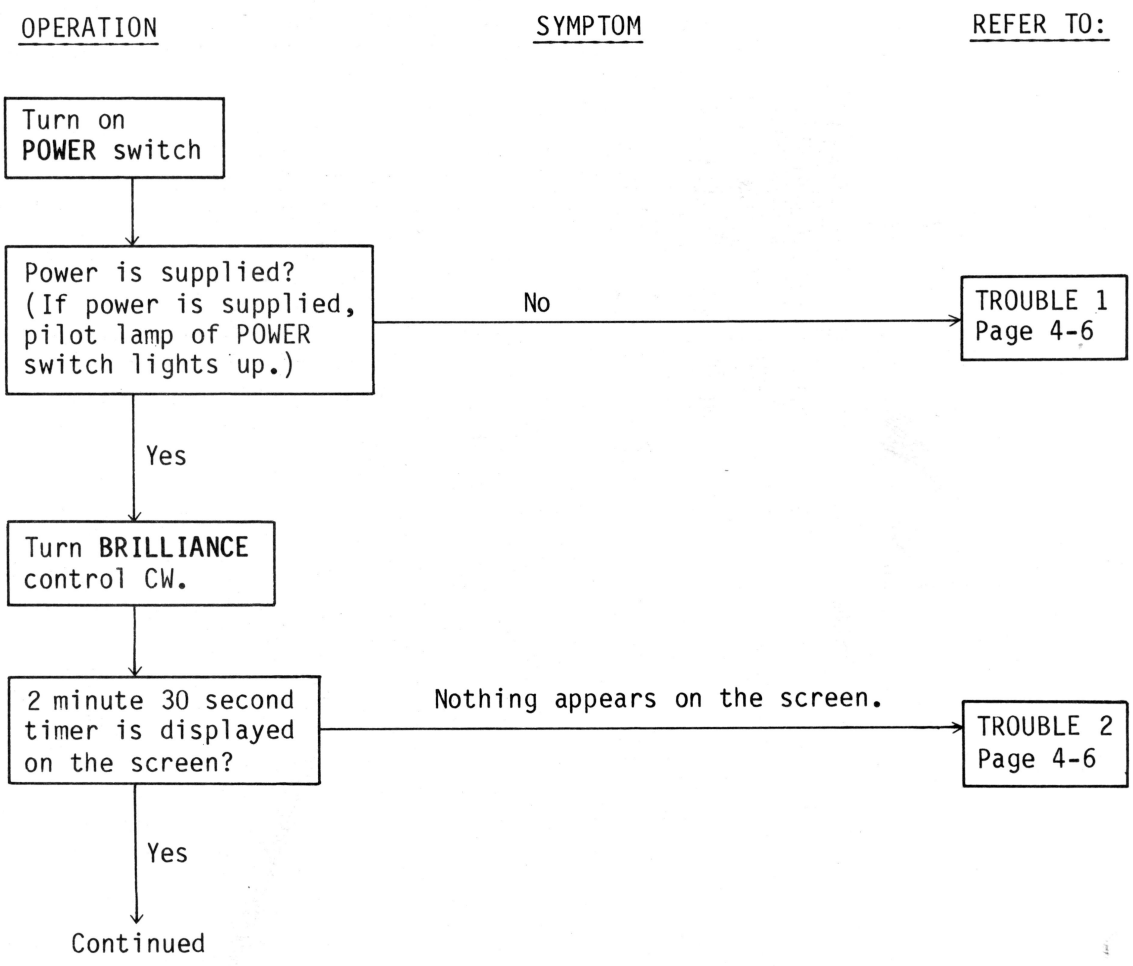
CHAPTER 4 TROUBLESHOOTING

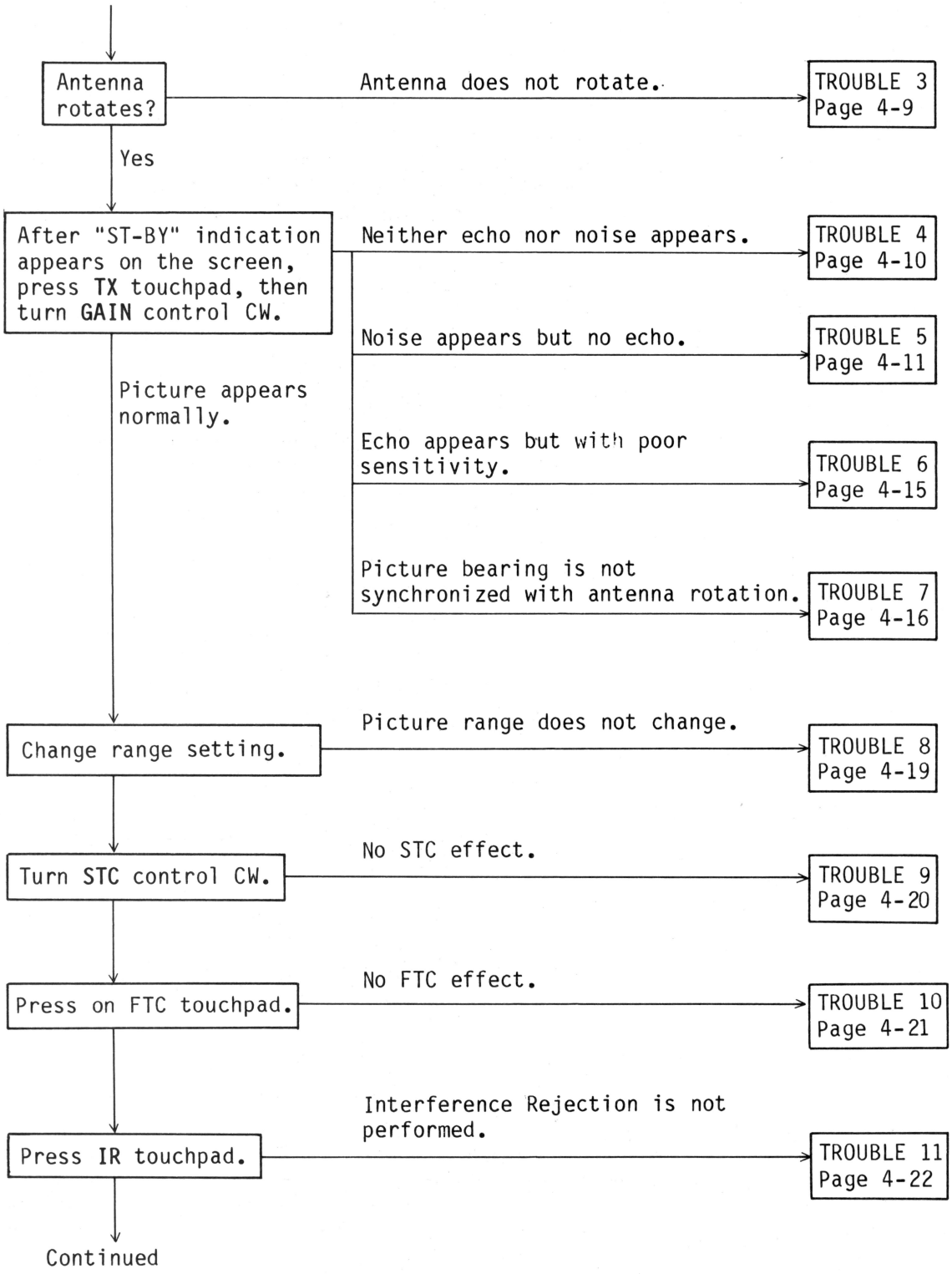
4.1 Trouble Tracing Chart

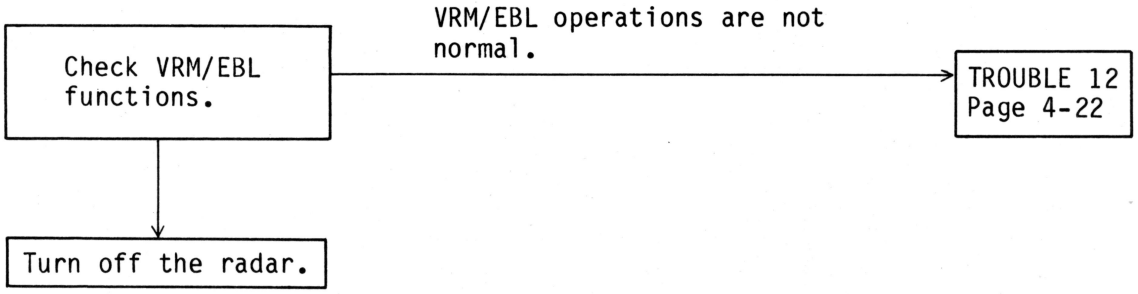
To facilitate the procedure for trouble tracing, the following flow-chart is arranged. After tracing down a particular "trouble" by using the flow-chart, proceed to "4.2 Troubleshooting" to identify faulty blocks or parts.

Before starting, preset the front panel controls and switches as shown to the right.

CONTROLS	POSITIONS
POWER	OFF
TUNE	Mid-travel
Others	Fully CCW




Antenna rotates?
Antenna does not rotate.
TROUBLE 3 Page 4-9
Yes
After "ST-BY" indication appears on the screen, press TX touchpad, then turn GAIN control CW.
Neither echo nor noise appears.
TROUBLE 4 Page 4-10
Noise appears but no echo.
TROUBLE 5 Page 4-11
Picture appears normally.
Echo appears but with poor sensitivity.
TROUBLE 6 Page 4-15
Picture bearing is not synchronized with antenna rotation.
TROUBLE 7 Page 4-16
Change range setting.
Picture range does not change.
TROUBLE 8 Page 4-19
Turn STC control CW.
No STC effect.
TROUBLE 9 Page 4-20
Press on FTC touchpad.
No FTC effect.
TROUBLE 10 Page 4-21
Press IR touchpad.
Interference Rejection is not performed.
TROUBLE 11 Page 4-22
Continued


Check VRM/EBL functions.
VRM/EBL operations are not normal.
TROUBLE 12
Page 4-22
Turn off the radar.

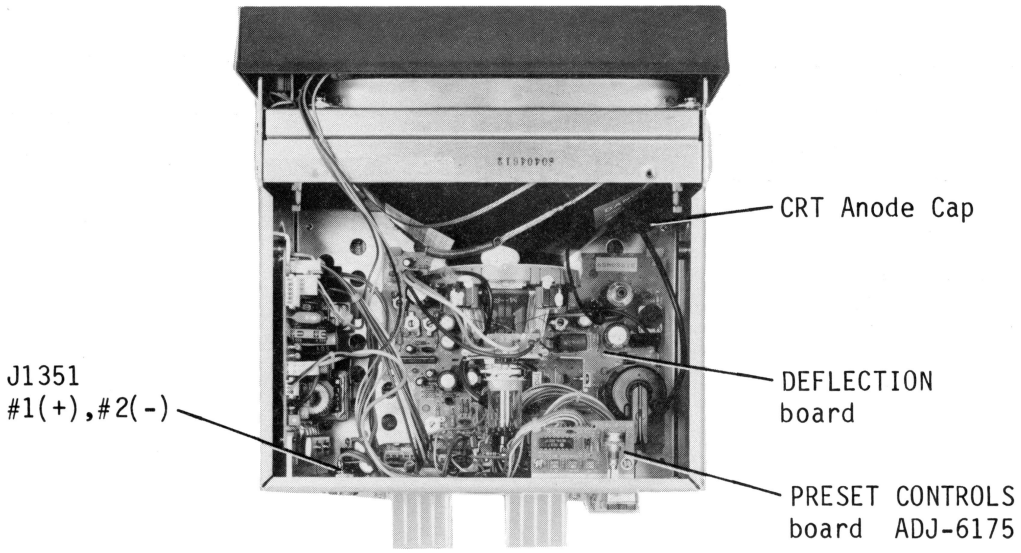


Fig.4-1 DISPLAY UNIT TOP VIEW (1)
WITH UNIT COVER REMOVED

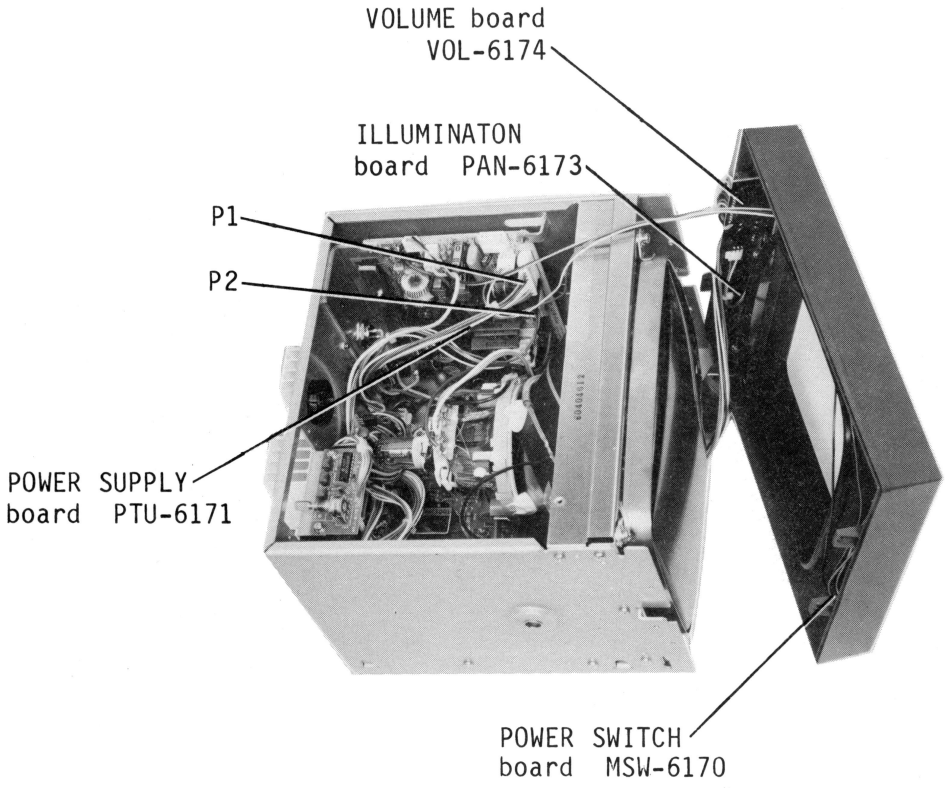


Fig.4-2 DISPLAY UNIT TOP VIEW (2)
WITH UNIT COVER REMOVED

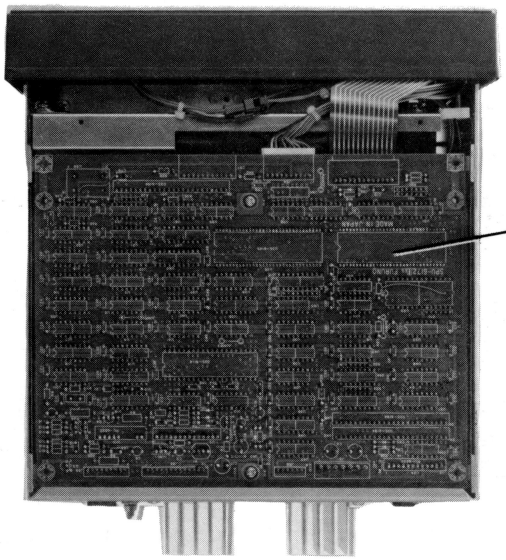


Fig.4-3 DISPLAY UNIT BOTTOM VIEW
WITH UNIT COVER REMOVED

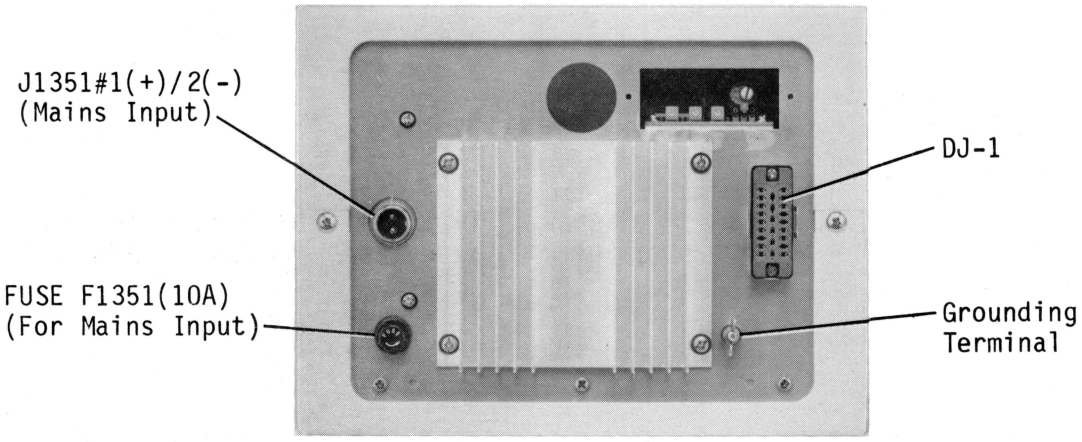


Fig.4-4 DISPLAY UNIT REAR VIEW

4.2 Troubleshooting

TROUBLE 1 Power is not supplied.

Cause: * Main fuse F1351 blown.
* Overvoltage or Low voltage of ship's mains.
* Short circuit on dc line.
* Faulty POWER SUPPLY board.

Check/Remedy: 1) Check if the main fuse F1351 is blown. See Fig.4-4. If it is blown, replace it with a new one.

2) If the fuse blows again, disconnect P1 (Fig.4-2) from the POWER SUPPLY board, insert a new fuse and turn on the radar again.

3) If the fuse blows once again, the POWER SUPPLY board may be faulty. Replace the board with a new one.

4) Check the mains input voltage as follows. See Fig.4-1.

Rating	Check Point
10.2 to 31.2Vdc	J1351 #1(+) - #2(-)

TROUBLE 2 Nothing appears on the screen.
(Characters/legend do not appear.)

Cause: * Faulty CRT H.V.
* Faulty PROCESSOR board (SPU-6172).
* Defective CRT.

Check/Remedy: 1) Check if the CRT heater is lit. If it is lit, adjust the CONTRAST pot.(R7) and BRIGHT pot.(R37) on the DEFLECTION board. See Fig.4-5.

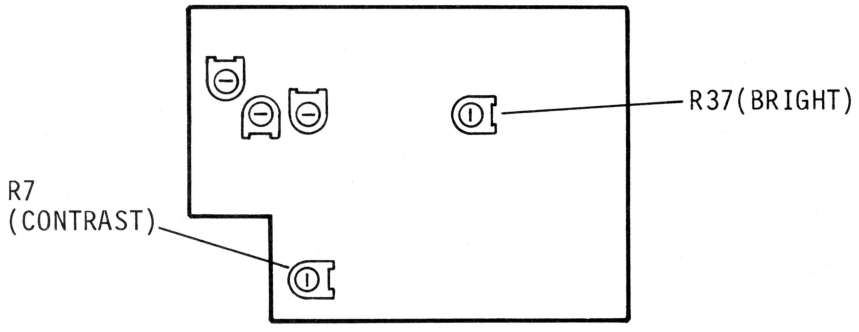


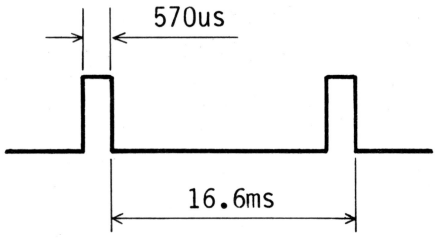
Fig.4-5 DEFLECTION Board (parts side)

2) When no picture appears on the screen despite the adjustments mentioned above, check the CRT high voltage as follows. Taking special care for H.V. charged (approx. 11.5kV), turn off the radar and pull out the CRT anode cap, then move it close to the chassis (approx. 8mm apart). If the CRT high voltage is normal, sparking will be occur.

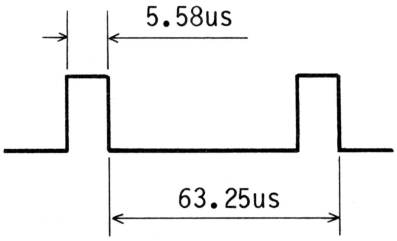
3) If sparking does not occur, the CRT may be faulty. Replace the CRT assembly with a new one.

4) If sparking occurs, the PROCESSOR board may be faulty. Replace the PROCESSOR board with a new one.

5) Check the vartical/horizontal synchro pulses at pin#5 (ver.) and pin#2 (hor.) of J56 on the PROCESSOR board by using an oscilloscope. If the pulses shown in Fig.4-6 are not observed, the CPU or U29 on the PROCESSOR board may be faulty. See Fig.4-8.



Waveform at Pin#5 of J56
on the PROCESSOR Board
(Vertical synchro.)



Waveform at Pin#2 of J56
on the PROCESSOR Board
(Horizontal synchro.)

Fig.4-6

6) Check the video signal at pin#4 of J56 on the PROCESSOR board. If the signal shown in Fig.4-7 is not observed, the Video RAM block (U42 to U46, U51 and U52) in the PROCESSOR board may be faulty. See Fig.4-8.

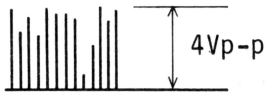


Fig.4-7 Pin#4 of J56 on the PROCESSOR Board (Video signal)

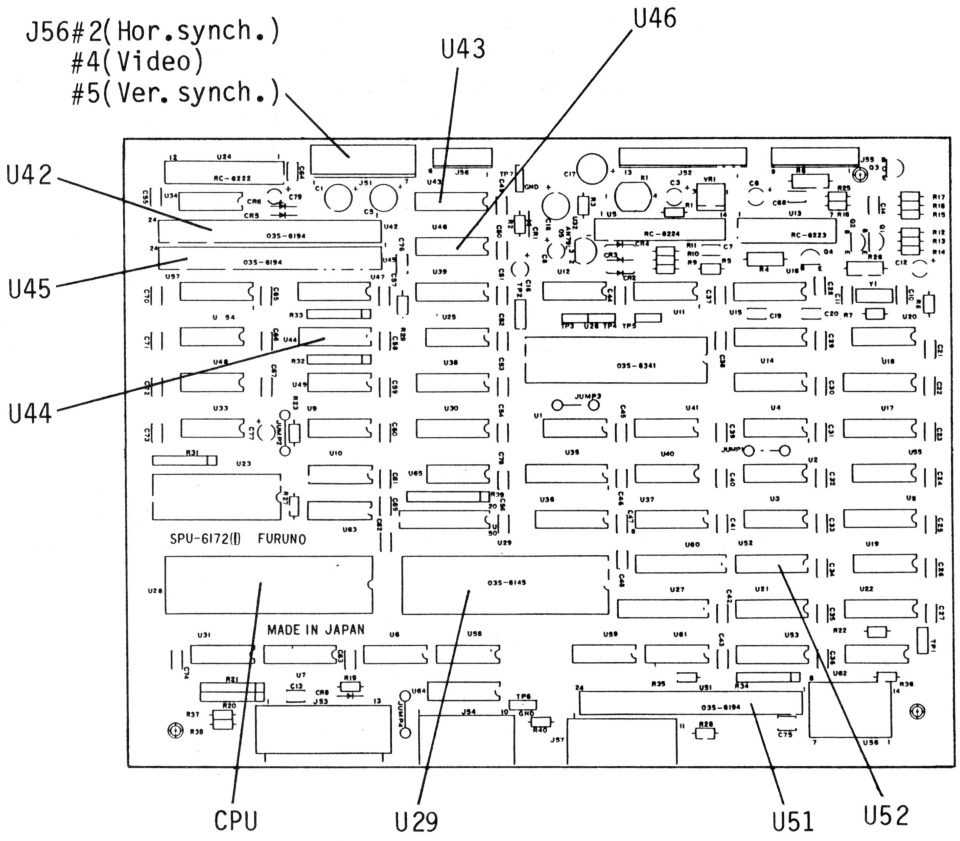


Fig.4-8 PROCESSOR Board (SPU-6172) solder side

TROUBLE 3 Antenna does not rotate.

Cause: * Scanner rotating mechanism jammed.
* Defective scanner motor.
* Faulty MOTOR CONTROL board.
* Faulty power supply circuit for scanner motor.
* Poor connection between scanner and display units.

Check/Remedy: 1) Rotate the antenna radiator by hand. If the radiator does not rotate smoothly, remove the radiator assembly from the scanner driving assembly. Then, replace the defective bearing with a new one. If the radiator rotates smoothly, the scanner motor is shorted or the MOTOR CONTROL board is faulty. See Fig.4-9.

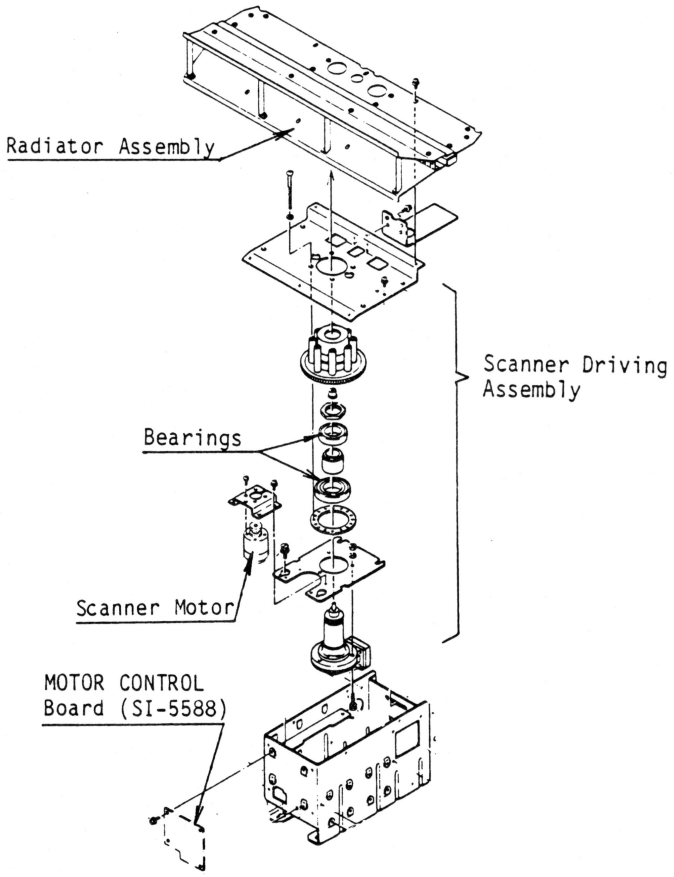


Fig.4-9 Scanner Unit

2) Check the power supply circuit for the motor. Measure the voltages at pins #1(-12V) and #2(+12V) of P/J2 on the POWER SUPPLY board. See Fig.4-2.

TROUBLE 4 Neither echo nor noise appears.

Cause: * Video signal line disconnected or shorted.
* Faulty IF AMP. board.
* Faulty PROCESSOR board (SPU-6172).

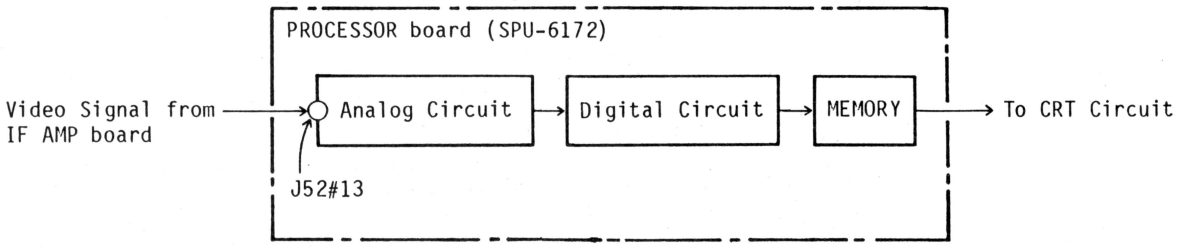


Fig.4-10

Check/Remedy: 1) Check the continuity and isolation of the video signal line between the scanner and display units. (Before checking with ohmmeter, disconnect the video signal line at both ends.)

2) Measure the receiving signal (video signal) at pin #13 of J52 on the PROCESSOR board by using an oscilloscope. See Fig.4-12. If the signal shown in Fig.4-11 is not obtained, the IF AMP. board may be faulty.

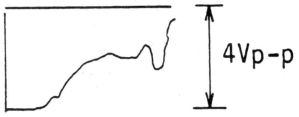


Fig.4-11 Video signal at pin#13 of J52 on the PROCESSOR Board

3) If the signal shown in Fig.4-11 is obtained, the PROCESSOR board is faulty. See Fig.4-12.

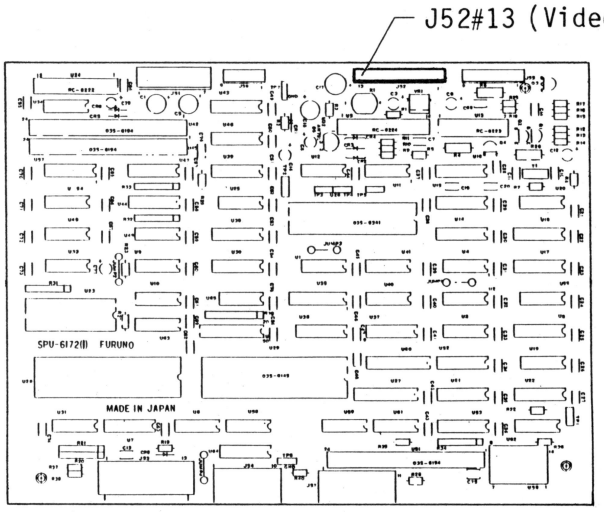


Fig.4-12 PROCESSOR Board (SPU-6172) solder side

TROUBLE 5 Noise appears but no echo.

Cause: * Defective magnetron.
* Faulty TX trigger generator in the display unit.
* Faulty modulator trigger circuit in the scanner unit.
* Defective PFN (Pulse Forming Network) or Pulse transformer.
* Defective MIC/limiter.

Check/Remedy: 1) Check the magnetron current for the following ratings. See Fig.4-13.

Rating	Check Point
Short Range: 1.3 to 2.4V Long Range: 1.8 to 2.4V	P801 #3(+) - #5(-)

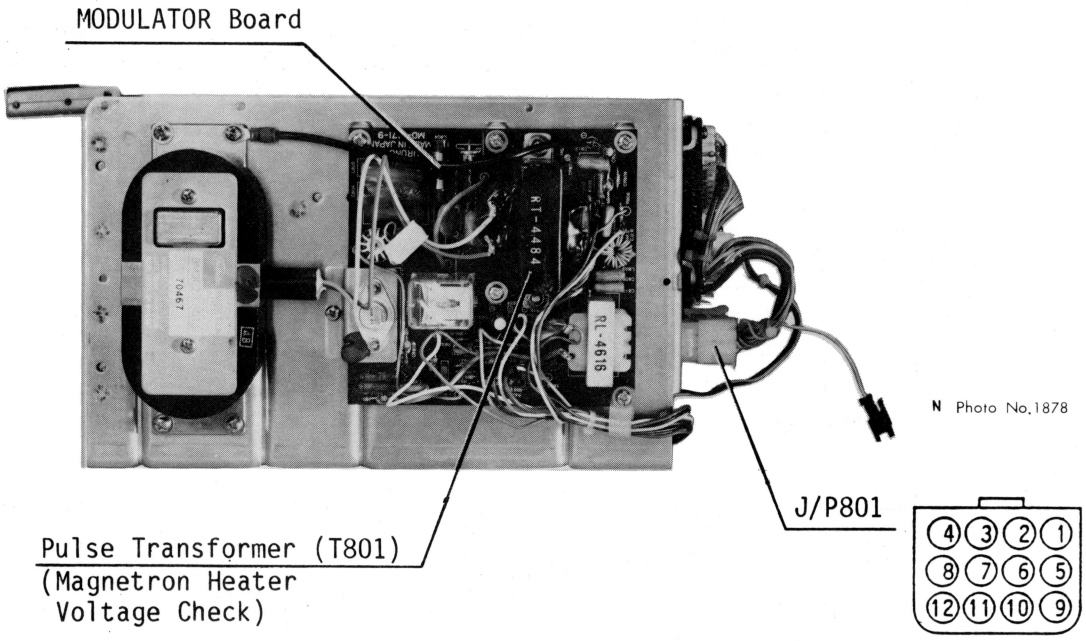


Fig.4-13 Transceiver Module Side View

2) If the magnetron current is within the rating, the MIC/limiter may be faulty. See Fig.4-18. Replace it with new one. (Handle the MIC/limiter as one device.)

3) When the magnetron current is not within the ratings, check the magnetron heater voltage for the followings rates. See Fig.4-13.

Rating	Check Point
6.0 to 6.6Vdc	T801 #4(+) - #6(-)

Condition: ST-BY; minimum CRT brilliance; scanner rotation suspended; 0.25 n.m. range

4) If the magnetron heater voltage is within the rating but the magnetron current is not obtained yet, check the TX trigger generator in the display unit (PROCESSOR board).

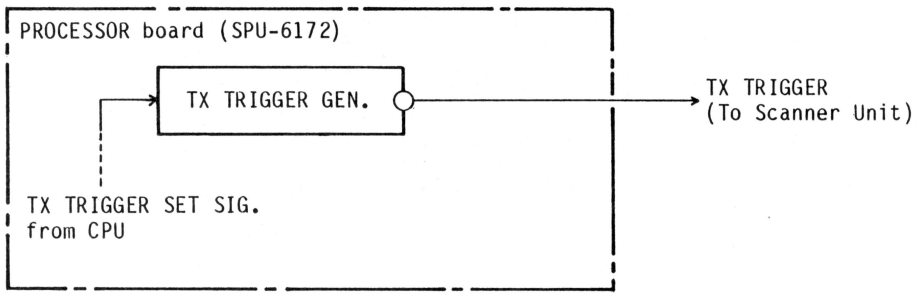


Fig.4-14

5) Check the TX trigger waveform at pin#1 of J52 on the PROCESSOR board (SPU-6172) by using an oscilloscope. See Figs.4-15 and 4-16.

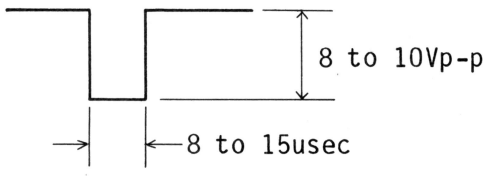


Fig.4-15 TX. Trigger at pin#1 of J52 on the PROCESSOR board

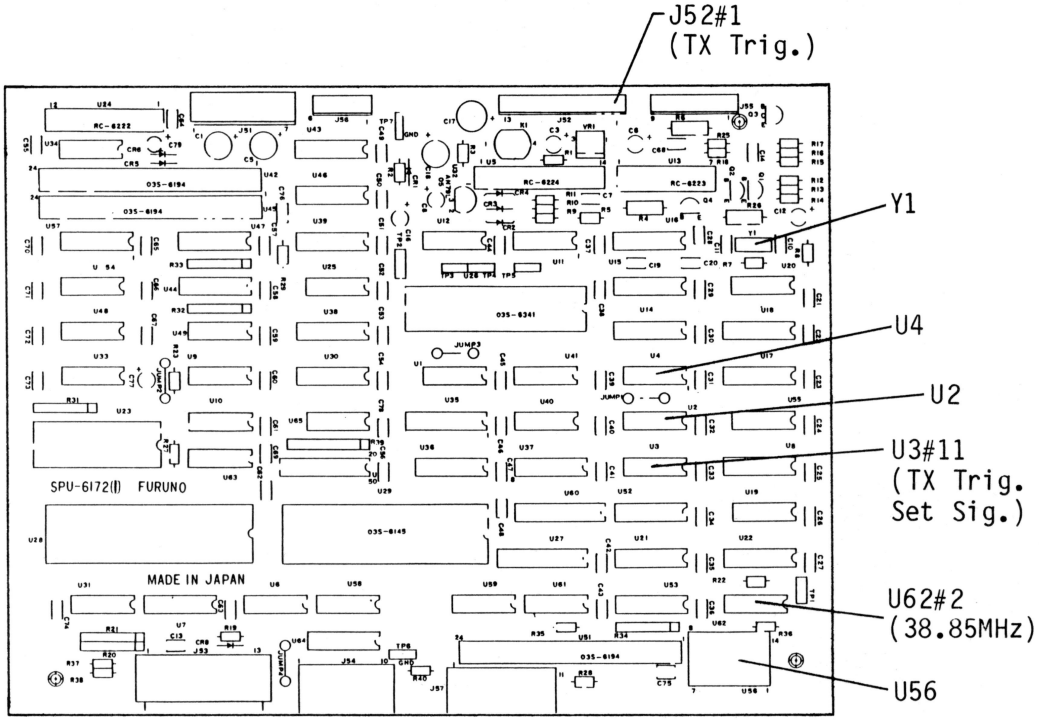


Fig.4-16 PROCESSOR Board (SPU-6171)

6) If it is not observed, check the TX trigger set signal from the CPU at pin #11 of U3 on the PROCESSOR board. See Figs. 4-16 and 4-17.

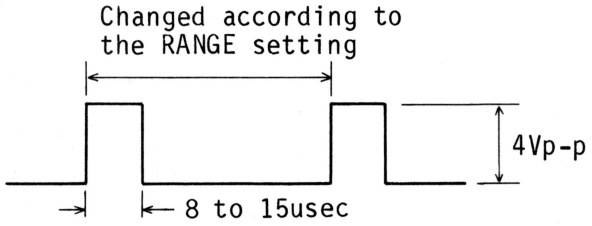


Fig.4-17 TX TRIG. SET SIG. at pin#11 of U3 on the PROCESSOR Board

7) If the signal is not obtained at pin #11 of U3, the timer IC (U2) on the PROCESSOR board may be faulty. See Fig.4-16. If it is obtained, U56/U62/U4 or Y1 (Crystal: 38.85MHz) on the PROCESSOR board may be faulty. Check the oscillation signal (38.85MHz) at the pin#2 of U62. See Fig.4-16.

8) If the TX trigger is obtained at pin#1 of J52 on the PROCESSOR board, check the scanner unit as follows.

9) Disconnect P4 on the POWER SUPPLY board; operate the radar in transmit condition. Check the modulator trigger waveform at the collector of Q822 on the MODULATOR board. See Fig.4-18. If it is not obtained, the modulator trigger circuit may be faulty.

10) If the modulator trigger pulse is normal, magnetron, pulse forming network or pulse transformer may be faulty. See Fig.4-18.

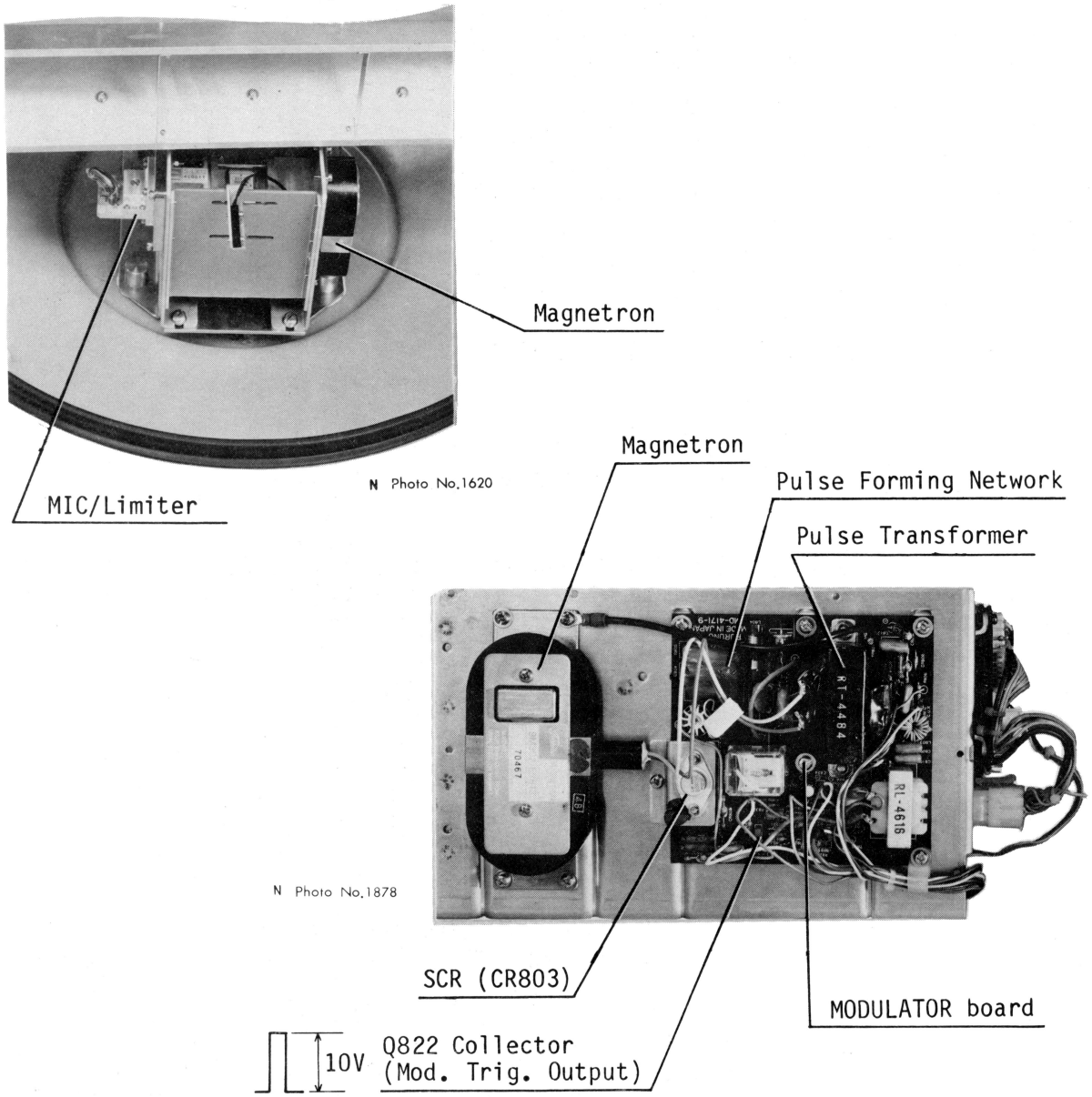


Fig.4-18

TROUBLE 6 Echo appears but with poor sensitivity.

Cause: * Deteriorated MIC.
* Deteriorated magnetron.
* Faulty **TUNE** control on the VOLUME board (VOL-6174).

Check/Remedy: 1) Adjust the **TUNE** control on the front panel. If best tuning is not obtained, check the **TUNE** control (VR401) and TUNE preset pot.(VR2) on the PRESET board. See Figs.4-19 & 4-20.

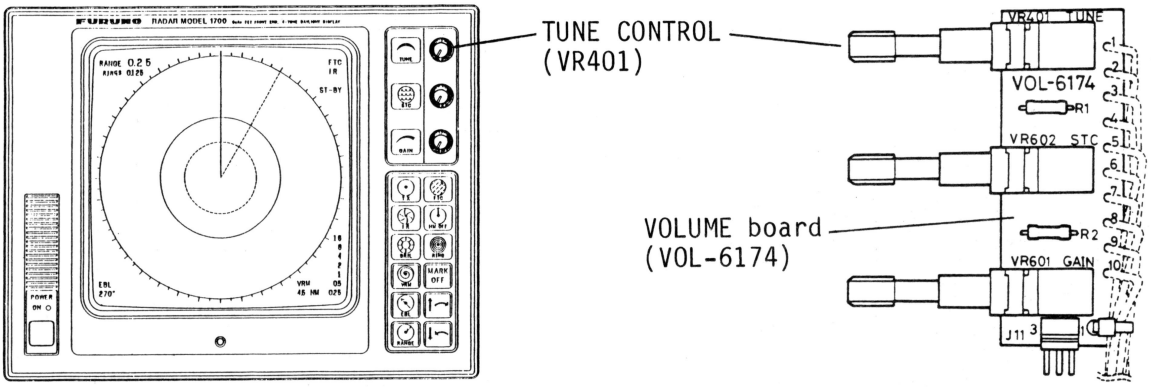


Fig.4-19 TUNE Control (VR401) on Display Front Panel

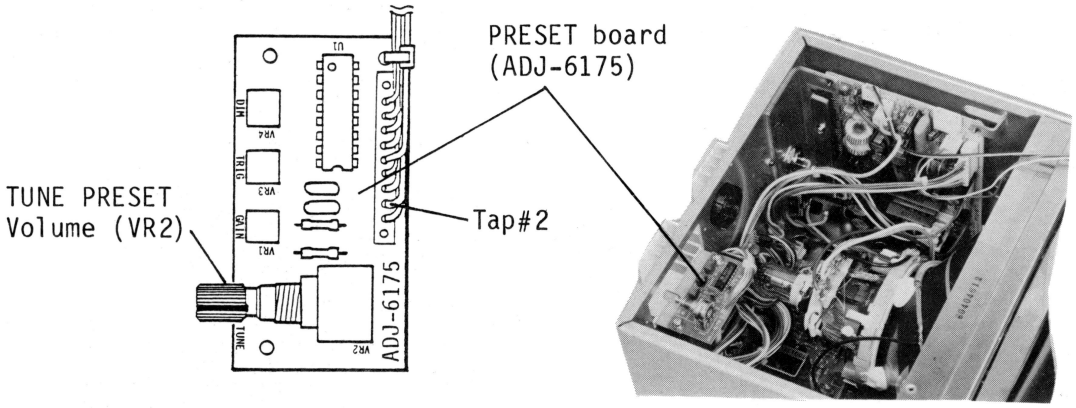


Fig.4-20 TUNE PRESET POT. (VR2) on PRESET board
(Display Unit Top View)

Measure the tune voltage at TAP#2 on the PRESET board. See Fig.4-20. If the voltage varies while turning the **TUNE** control (VR401), VR401 is normal. (The voltage is preset around +20Vdc with VR2. When the **TUNE** control is turned, the voltage varies about 2Vdc.)

2) Check the magnetron current referring to "TROUBLE 5" on page 4-11. If the magnetron current is far out of the rating, replace the magnetron with a new one. If it is OK, the MIC may be faulty.

TROUBLE 7 Picture bearing is not synchronized with antenna rotation.

Cause: * Defective heading flash key.
* Faulty MOTOR CONTROL board.
* Defective tacho-meter in the scanner motor.
* Faulty PROCESSOR board (SPU-6172).

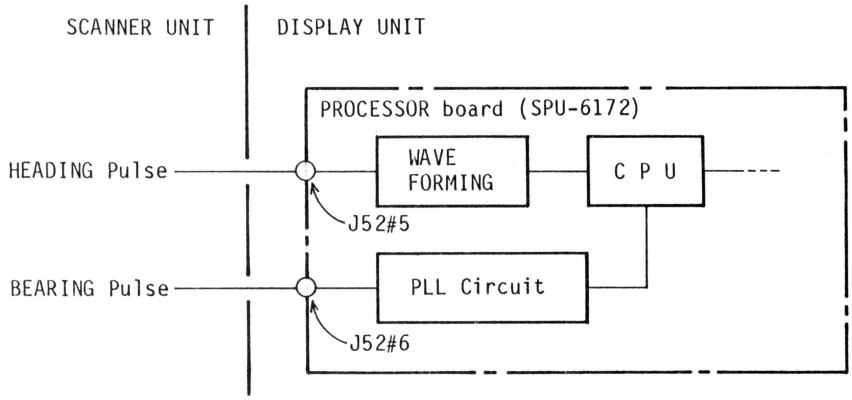


Fig.4-21

Check/Remedy: 1) To check the heading flash key, connect a multimeter, set at 10Vdc, between pin #5 of J52 on the PROCESSOR board and the ground. See Fig.4-22. In normal operation, the meter swings from +5V to 0V when the antenna radiator faces dead ahead. If the meter indication stays at +5V or 0V, the heading flash key (Fig.4-23) may be faulty or connection between the scanner and display units is cut off.

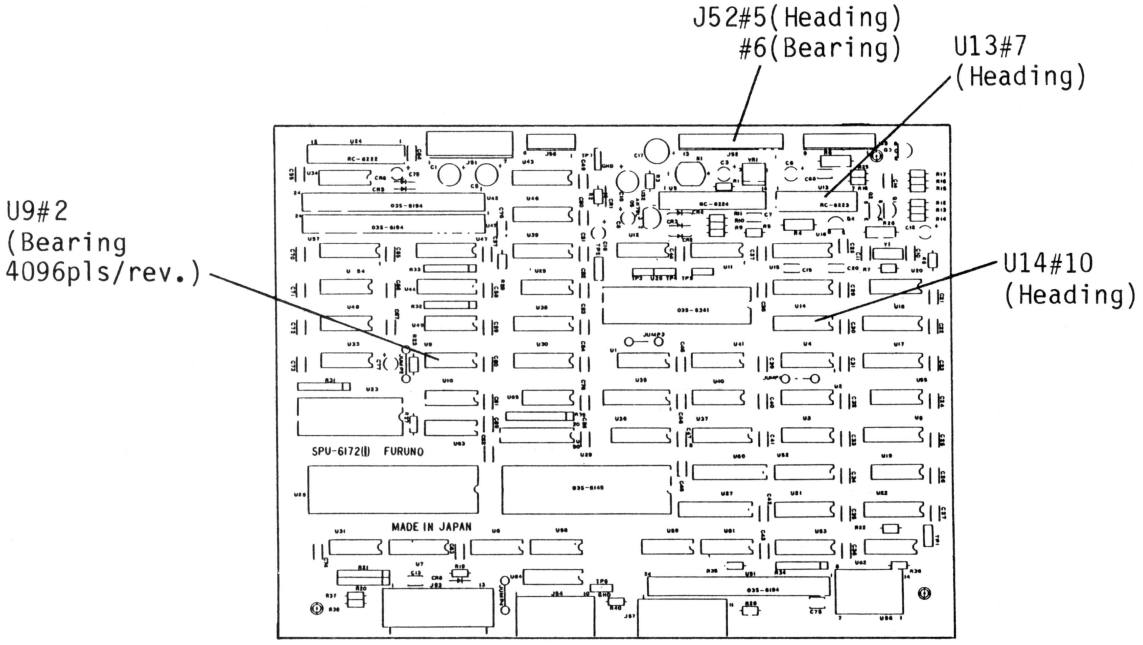


Fig.4-22 PROCESSOR Board (SPU-6172) solder side

2) To check the bearing signal, connect an oscilloscope between pin #6 of J52 and the ground. See Fig.4-22. If 450 pulses/rotation (180Hz) are not obtained at pin#6, check the scanner motor speed on the MOTOR CONTROL board as following rate. See Fig.4-23 for the locations of check point and adjuster.

Rating	Adjuster	Check Point
180Hz	VR901	TP904 #3 and #4

3) If the adjustment mentioned above is not effective, the MOTOR CONTROL board may be faulty. Measure the voltage between TP904 #3 and #4. If it is less than 100mVp-p, a tachometer in the scanner motor may be faulty. Replace the scanner motor with a new one.

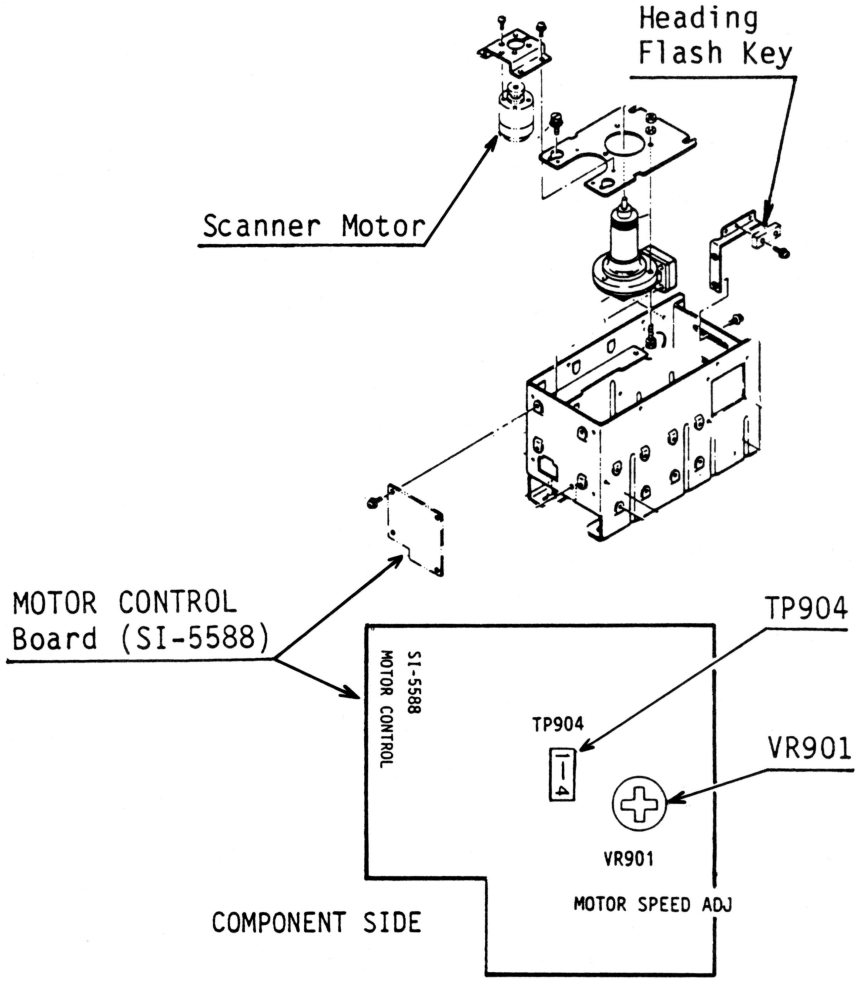


Fig 4-23

4) Check the heading pulse at pin #7 of U13 on the PROCESSOR board. If it is not obtained, U13 may be faulty. See Fig.4-22.

5) Check the bearing pulse (4096 pulses/rotation) at pin #2 of U9 on the PROCESSOR board. If it is not obtained or the number of bearing pulses does not coincide with 4096, the PLL (Phase Locked Loop) circuit in the PROCESSOR board is faulty. Replace the board with a new one.

6) If both heading and bearing pulses are normally obtained at pins #2 of U9 (bearing) and #10 of U14 (heading) respectively, the PROCESSOR board may be faulty.

TROUBLE 8 Picture range does not change.

Cause: * Faulty TOUCHPAD KEY (FKB-6282)
* Faulty PROCESSOR board (SPU-6172).

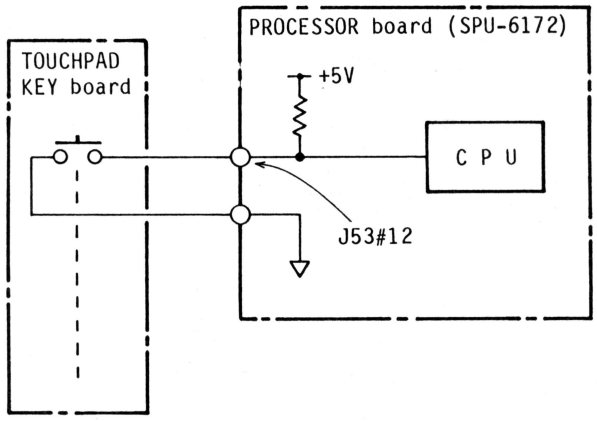


Fig.4-24

1) Check the output level of pin#12 of J53 on the PROCESSOR board. See Fig.4-25. If the output level is not down to OV when the RANGE touchpad is pressed, the touchpad key is faulty.

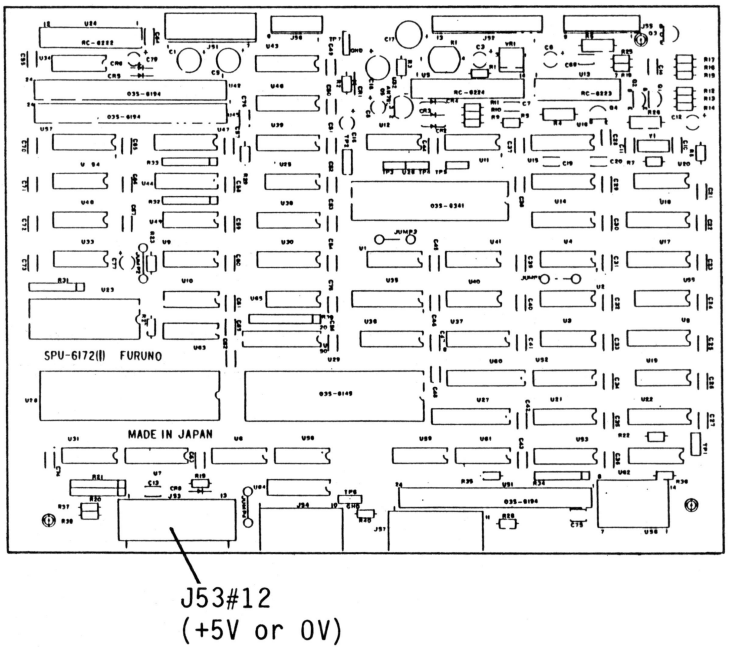


Fig.4-25 PROCESSOR Board (SPU-6172) solder side

TROUBLE 9 No STC effect.

Cause: * Faulty STC circuit.

Check/Remedy: 1) Check the STC waveform at the test point TP602 by using an oscilloscope.

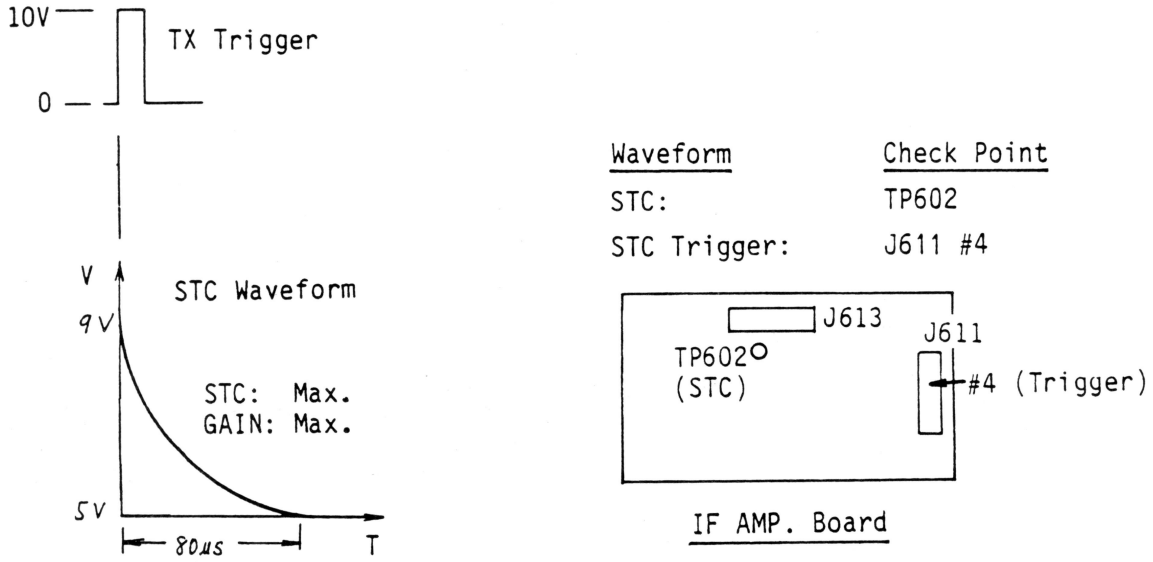


Fig.4-26 STC/Trigger Check Points

2) If the waveform is not obtained, check the STC trigger at J611#4.

3) If the STC trigger is obtained but the STC waveform is not obtained, replace the IF AMP. board with a new one.

TROUBLE 10 No FTC effect.

Cause: * Defective relay (K1) on the PROCESSOR board (SPU-6172).
* Faulty **FTC** circuit (U5/U27 on the PROCESSOR board).

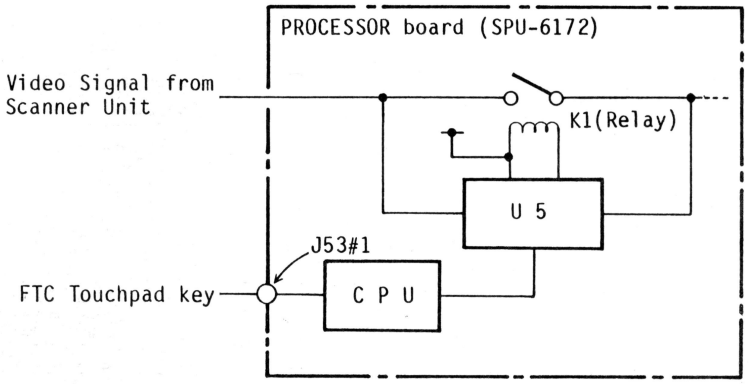


Fig.4-27

Check/Remedy: 1) Check the voltage at pin #1 of J53 on the PROCESSOR board. When the **FTC** touchpad on the front panel is pressed ON, confirm that the voltage becomes 0V. If not, the **FTC** control circuit (U5/U27) may be faulty. If the voltage goes 0V, the relay (K1) on the PROCESSOR board may be faulty. See Fig.4-28.

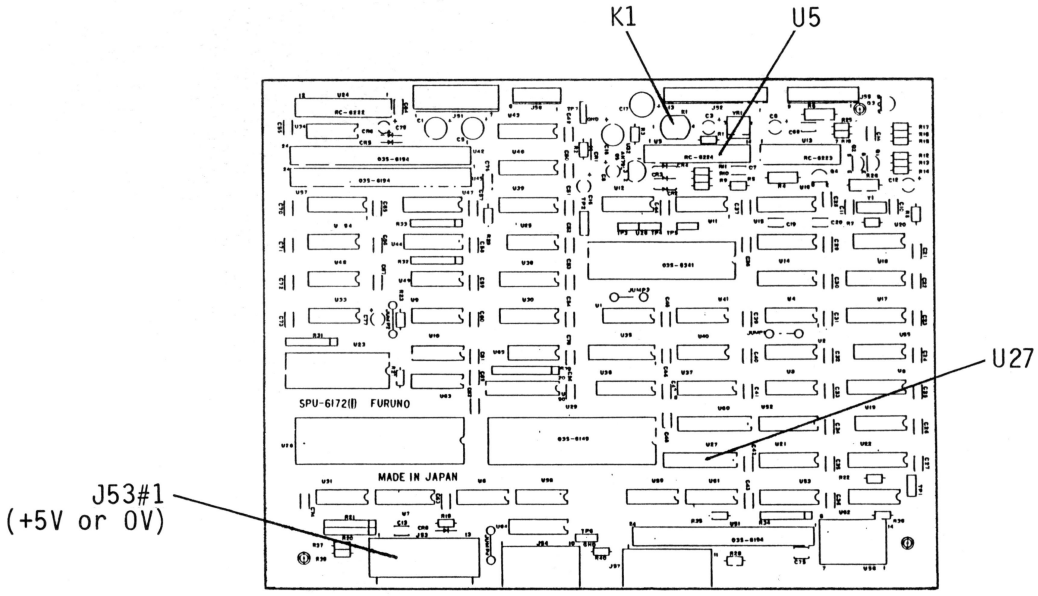


Fig.4-28 PROCESSOR Board (SPU-6172) solder side

TROUBLE 11 Interference Rejection is not performed.

Cause: * Faulty PROCESSOR board (SPU-6172).
* Poor contact of the TOUCHPAD KEY.

Remedy: 1) Replace the PROCESSOR board with a new one.

TROUBLE 12 VRM/EBL operations are not normal.

Cause: * Defective TOUCHPAD KEY (FKB-6282).
* Faulty PROCESSOR board (SPU-6172).

Check/remedy: 1) Check the voltage at pin #5 of J53 on the PROCESSOR board. See Fig.4-29.

2) If the voltage is not down to 0V when the RING touchpad is pressed, the key may be faulty. If the voltage goes down to 0V, the PROCESSOR board may be faulty. Replace the board with a new one.

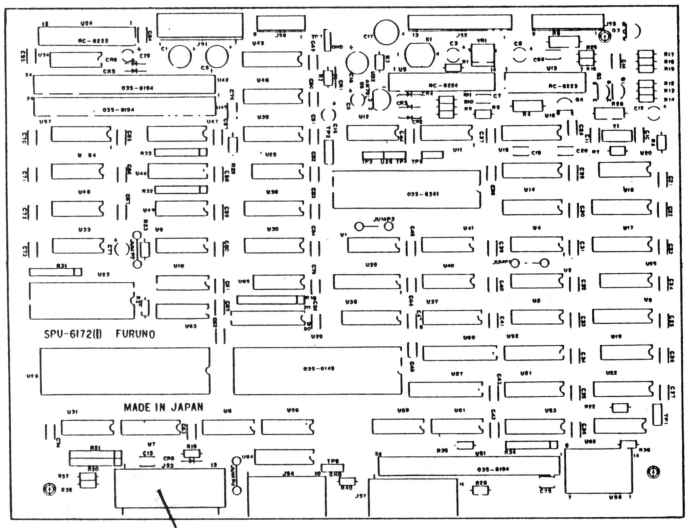


Fig.4-29 PROCESSOR Board (SPU-6172) solder side

CHAPTER 5 PARTS LOCATION

Display Unit

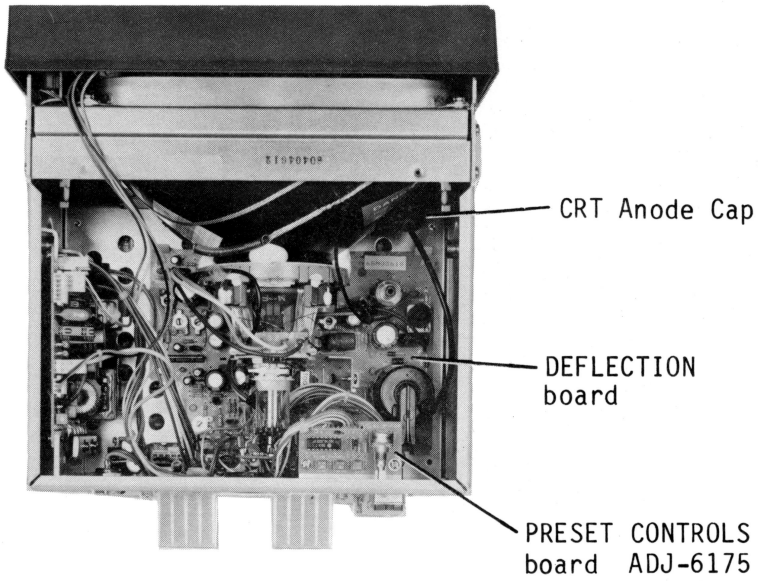


Fig.5-1 DISPLAY UNIT TOP VIEW (1) WITH THE COVER REMOVED

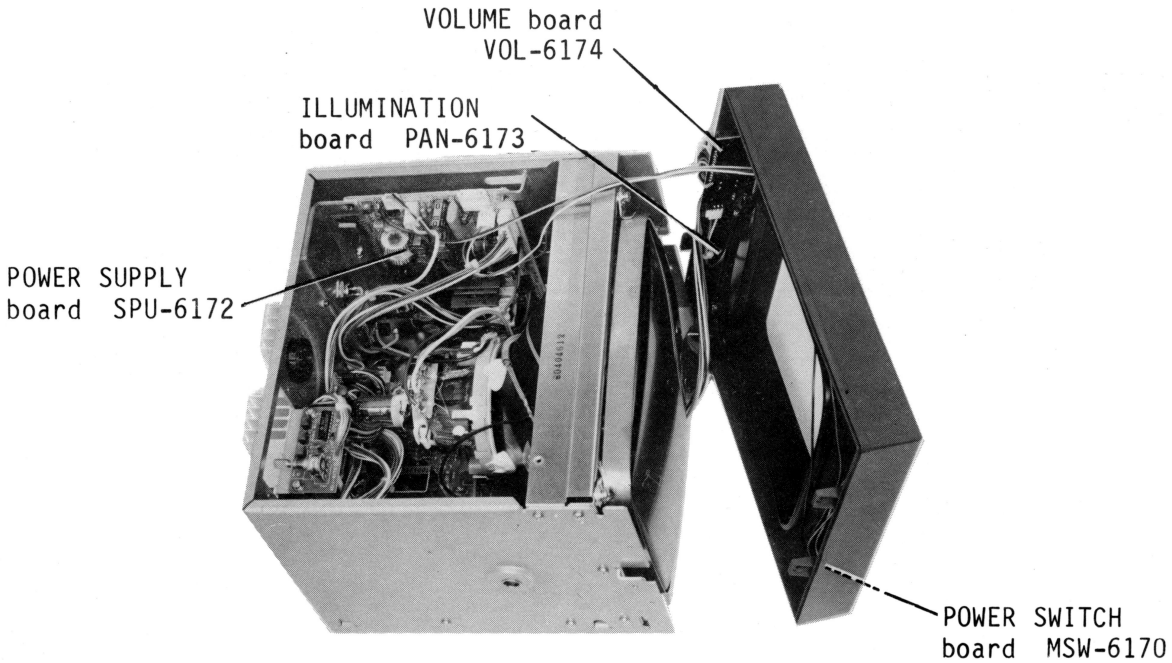


Fig.5-2 DISPLAY UNIT TOP VIEW (2) WITH THE COVER REMOVED

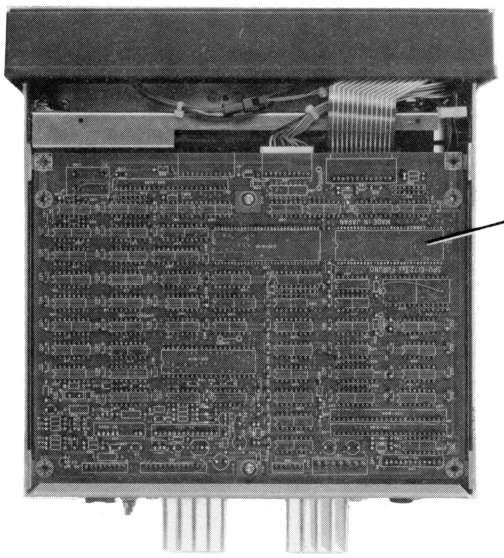


Fig.5-3 DISPLAY UNIT BOTTOM VIEW
WITH THE COVER REMOVED

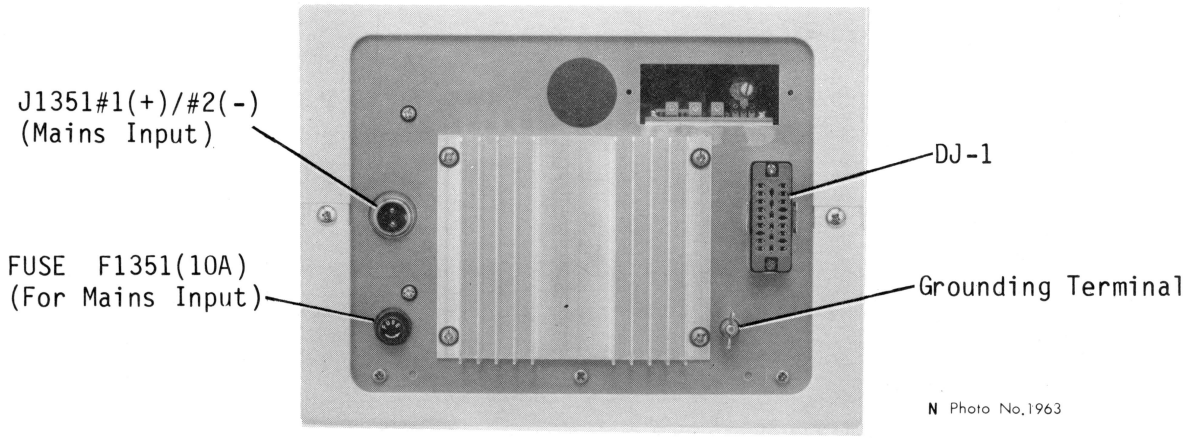


Fig.5-4 DISPLAY UNIT REAR VIEW

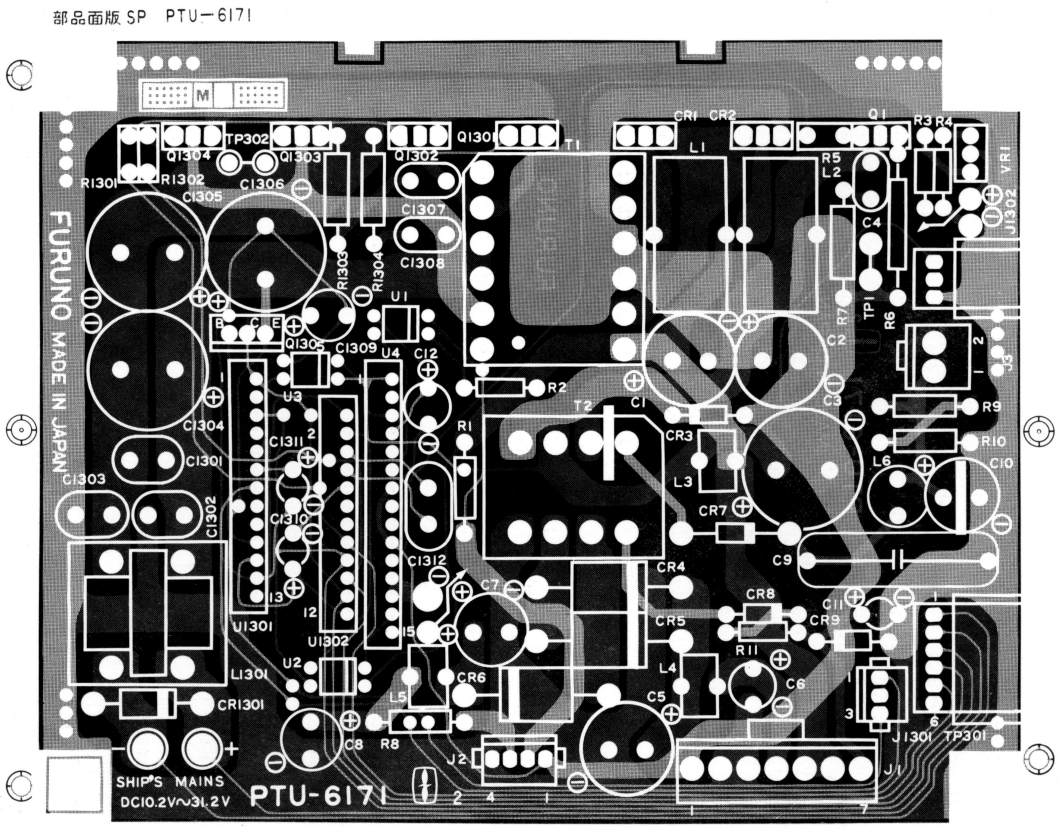


Fig.5-5 POWER SUPPLY board (PTU-6171)

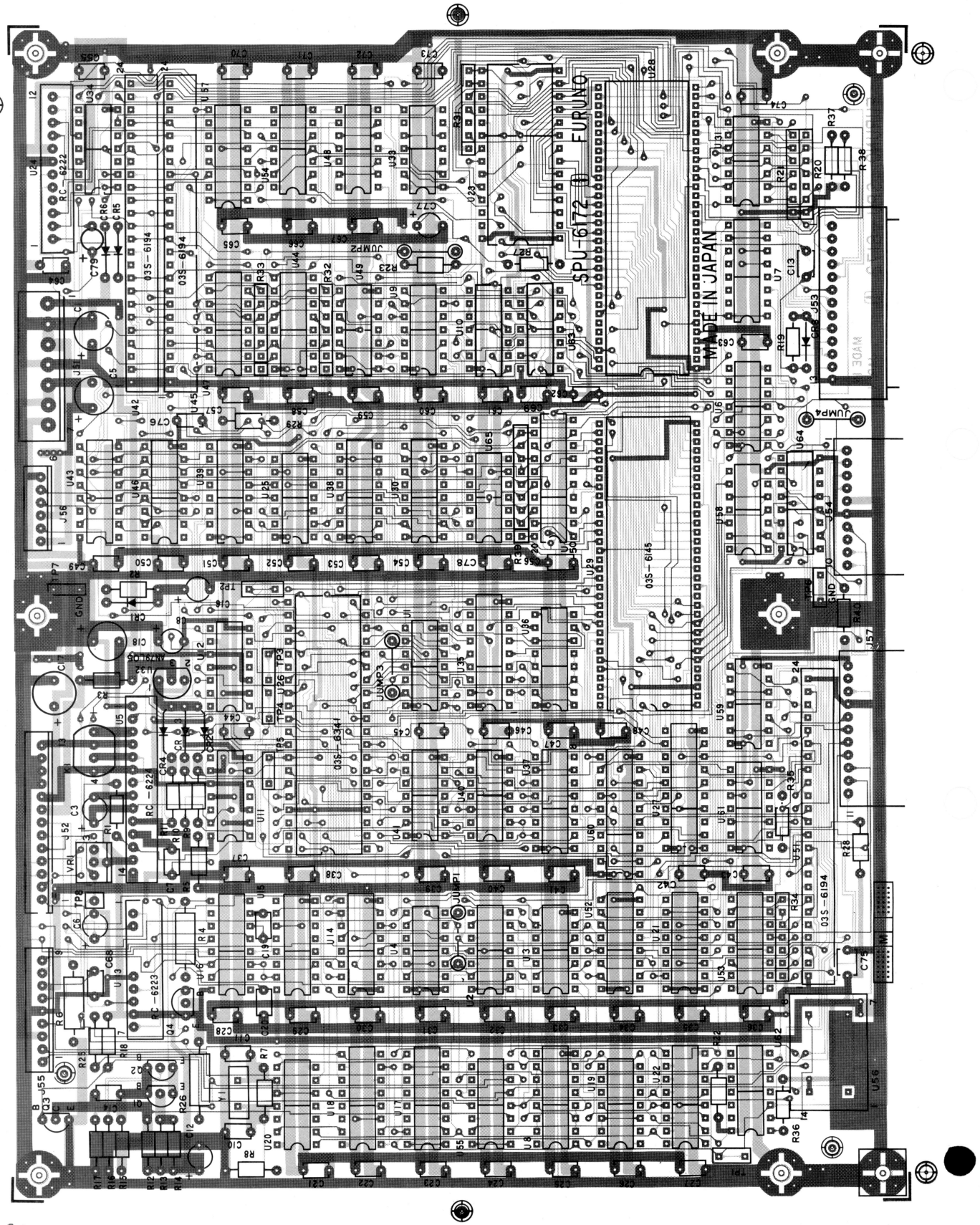


Fig.5-6 PROCESSOR board (SPU-6172)

Scanner Unit

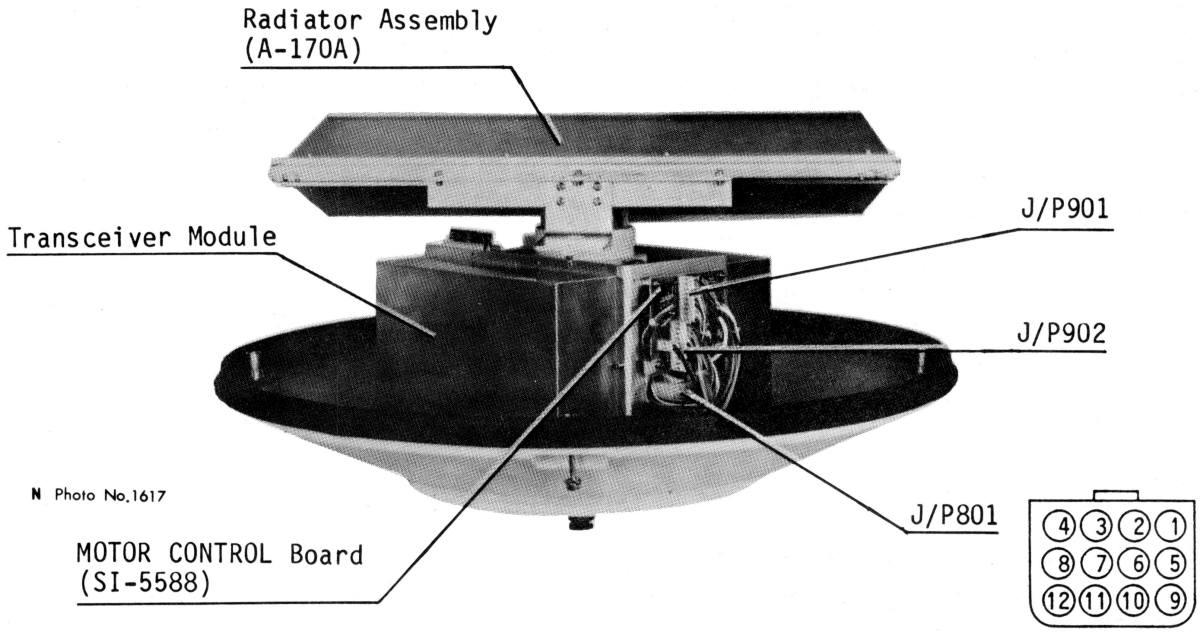


Fig.5-7 Scanner Unit with Transceiver Module

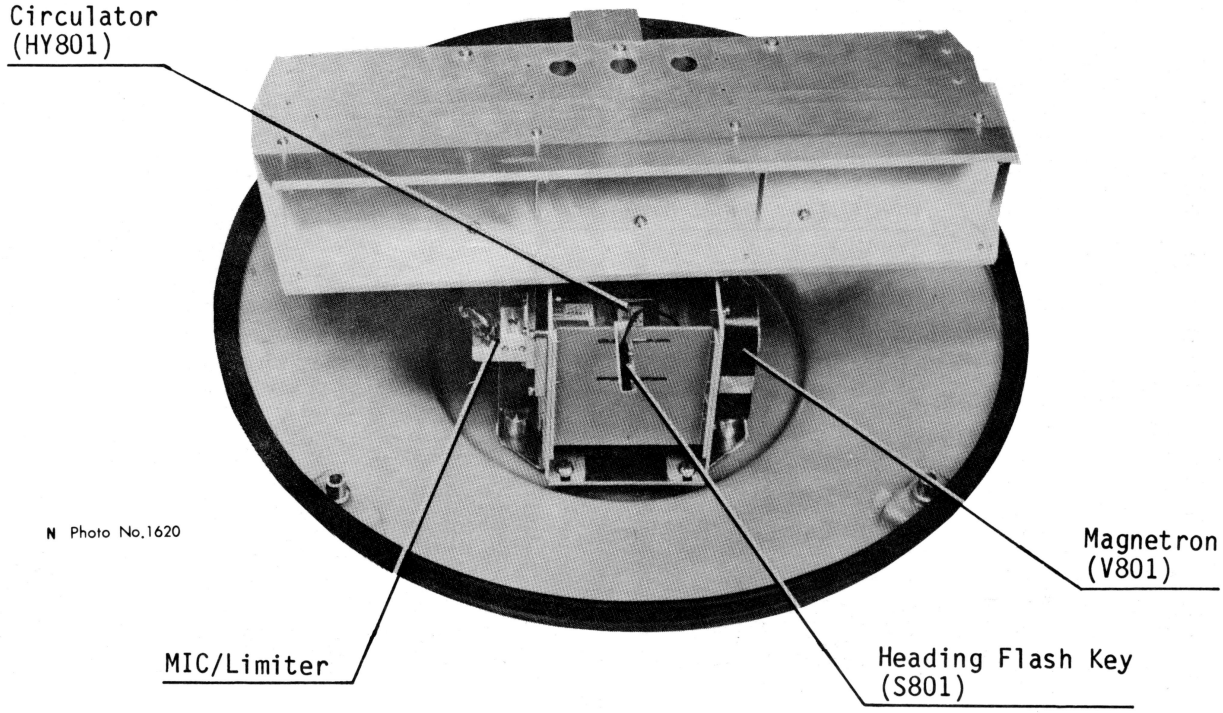
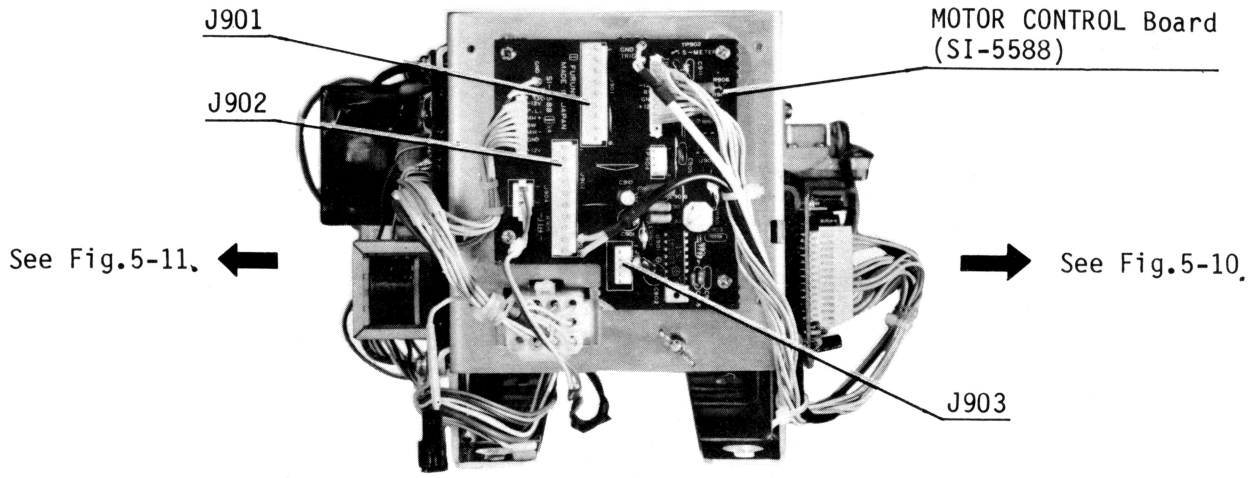
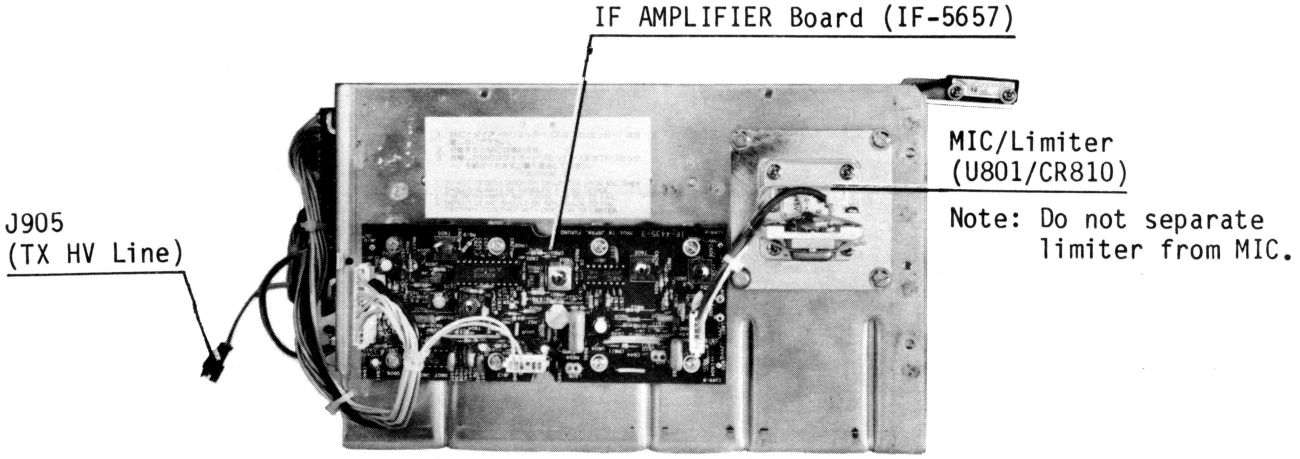


Fig.5-8



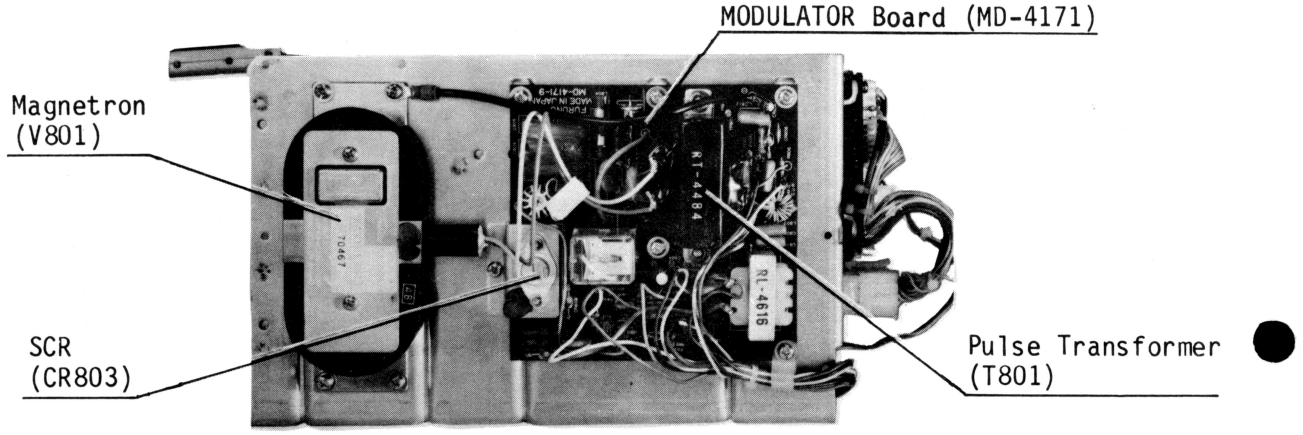
N Photo No.1879

Fig.5-9 Transceiver Module



N Photo No.1877

Fig.5-10 Transceiver Module Side View



N Photo No.1878

Fig.5-11 Transceiver Module Side View

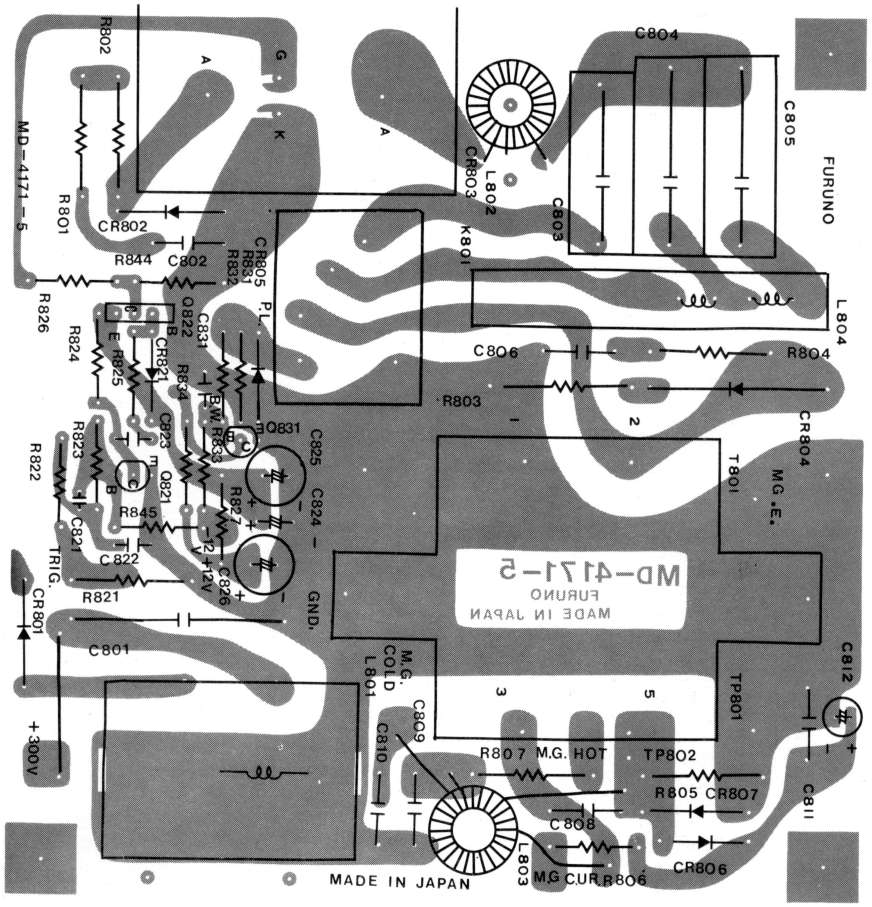


Fig.5-12 MODULATOR Board (MD-4171)

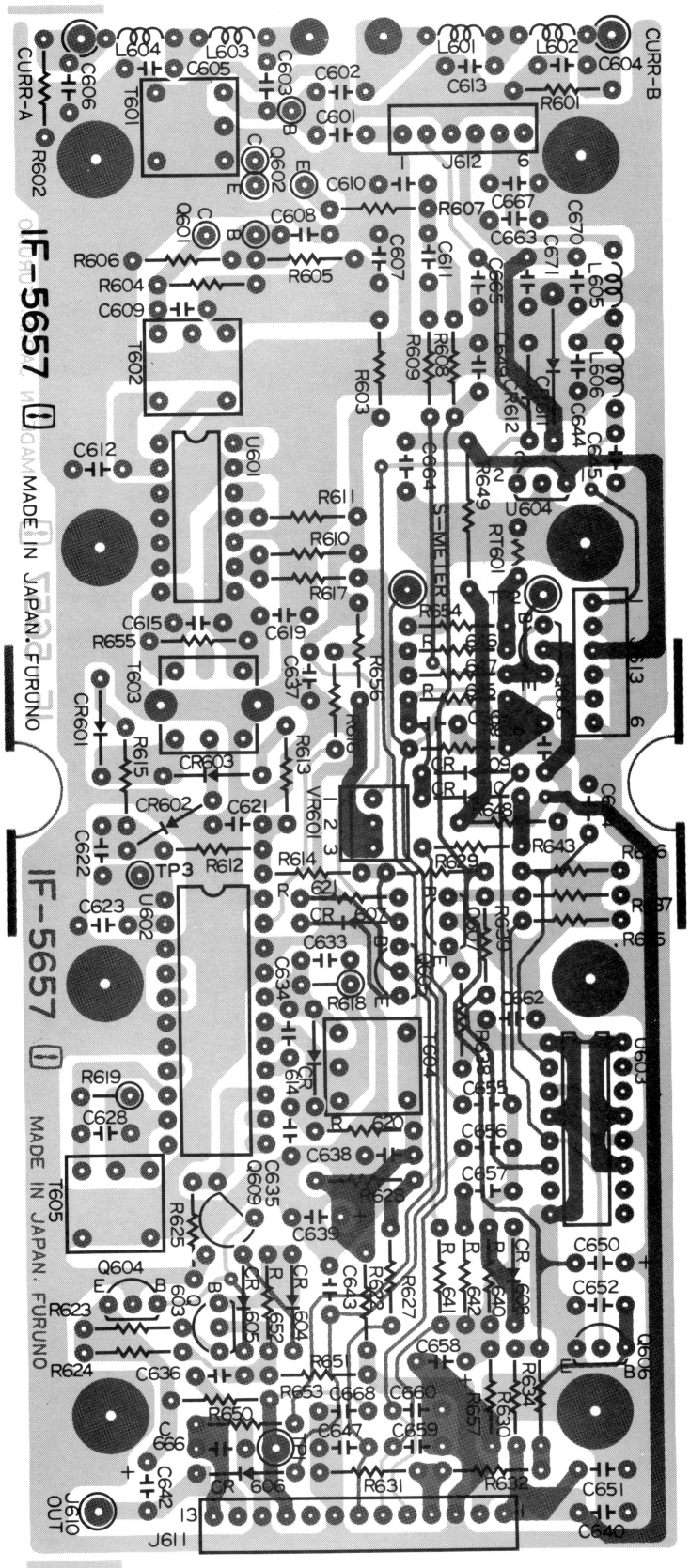


Fig.5-13 IF AMPLIFIER Board (IF-5657)

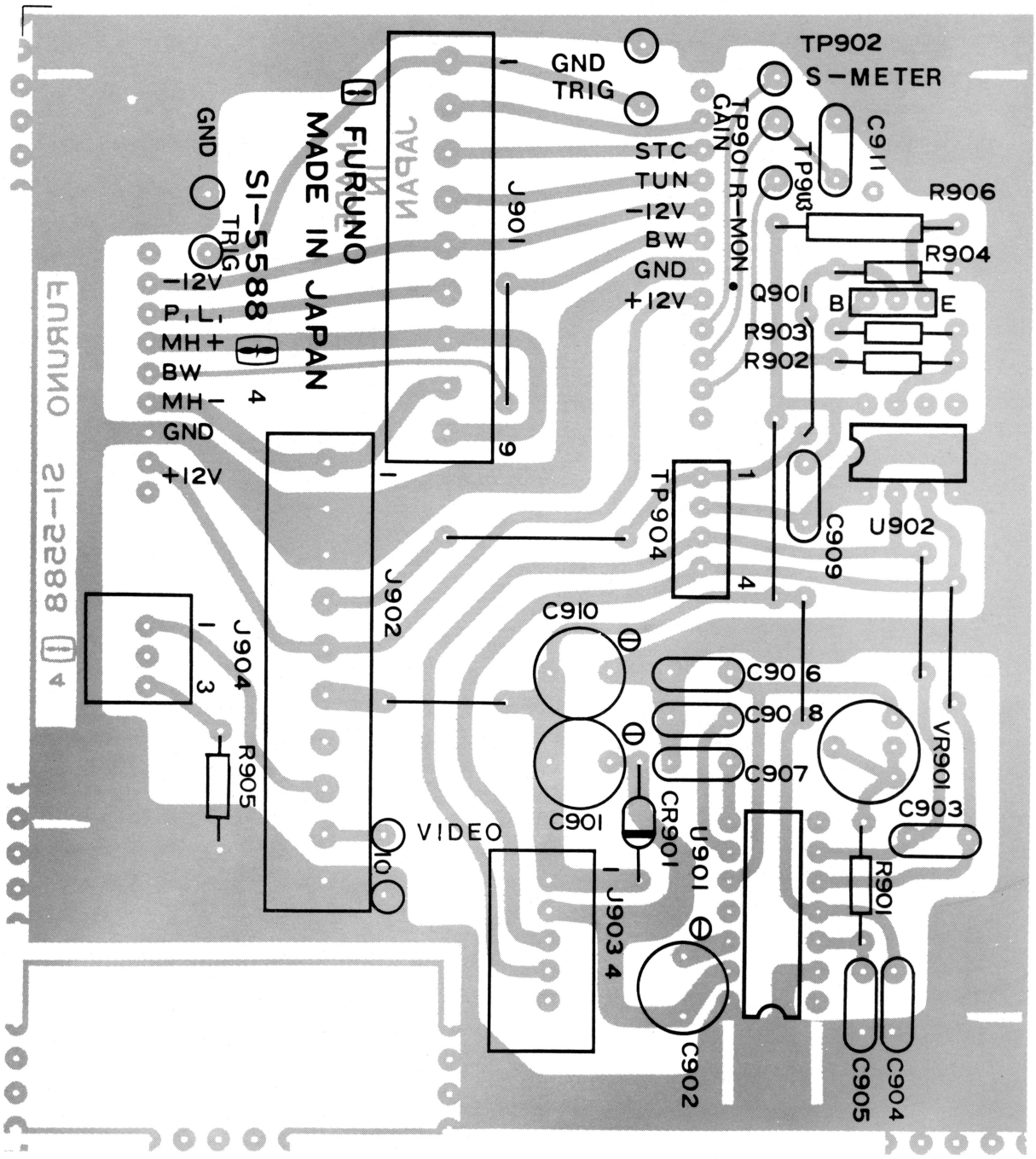


Fig.5-14 MOTOR CONTROL Board (SI-5588)

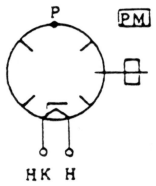
CHAPTER 6 TECHNICAL DATA

6.1 Characteristics of Major Electrical Components

Parts Name	Page
1. Magnetron	6-2
2. Circulator	6-3
3. Limiter	6-4
4. MIC	6-5
5. Motor	6-6
6. Transformers	6-7 to 6-9
7. Choke Coil	6-10
8. Digital Integrated Circuits	6-11
9. Linear Integrated Circuits	6-12 to 6-18
10. Transistors	6-19 & 6-20
11. Field Effect Transistor	6-21
12. Diodes	6-22 & 6-23
13. Zener Diodes	6-24
14. Thyristor (SCR)	6-25
15. Light Emitting Diode (LED)	6-26
16. Photo Coupler	6-27

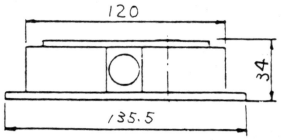
SPECIFICATIONS OF MAGNETRONS

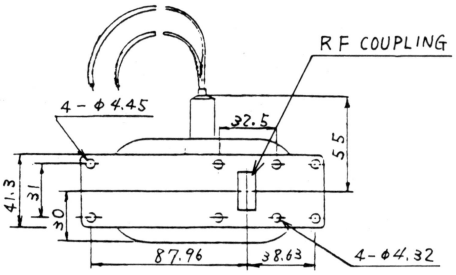
Type:	9M302/E3513, L
Furuno Code No.:	000-101-733
Applications:	9410MHz band radar pulse transmission



Maximum Ratings

	Min.	Max.	Unit
Heater Voltage (Ef)	5.7	6.9	V
Cathode pre-heating time (tk)	120		sec.
Peak anode voltage (eb)	3.2	3.8	KV
Rate of rise of voltage pulse (rrv)		60	KV/us
Peak anode current (ib)	2.5	3.5	A
Average anode current (Ib)		3.5	mAdc
Peak input power (pi)		13	KW
Average input power (Pi)		13	W
Duty cycle (Du)		0.001	
Pulselength (tp)	0.05	1.0	us
VSWR (6∠)		1.5	
Plate temperature at test point		120	°C





Electrical Characteristics

	Test Condition	Min.	Typ.	Max.	Unit
Heater current	Ef = 6.3V	0.43	0.52	0.6	A
Peak plate voltage	tp = 0.9 - 1.1us Du = 0.001 Ib = 3.0mAdc	3.3	3.5	3.7	KV
Average output power		3.0			W
Frequency		9380	9410	9440	MHz
Spectrum Bandwidth	ib = 2.5 - 3.5A		1.2/tp	2.5/tp	MHz
Missing pulses (stability)				0.25	%
Frequency pulling	6∠ = 1.3 min.			18	MHz/°C
Temperature coefficient	Tp = 40 - 70 °C			-0.25	MHz
Life		500			hrs

NOTES: 1. Pre-heating time required is 120 seconds minimum for ambient temperature in excess of 0°C and 180 seconds minimum for 0°C to -55°C.

2. Frequency pulling denotes the frequency variation produced in the period of 5 minutes. The measurement is done within 15 minutes after the start of the test.

3. The life of the component is exhausted when the average output power drops to 2.4W and the ratio of missing pulses increases to 1% under the test condition stated above.

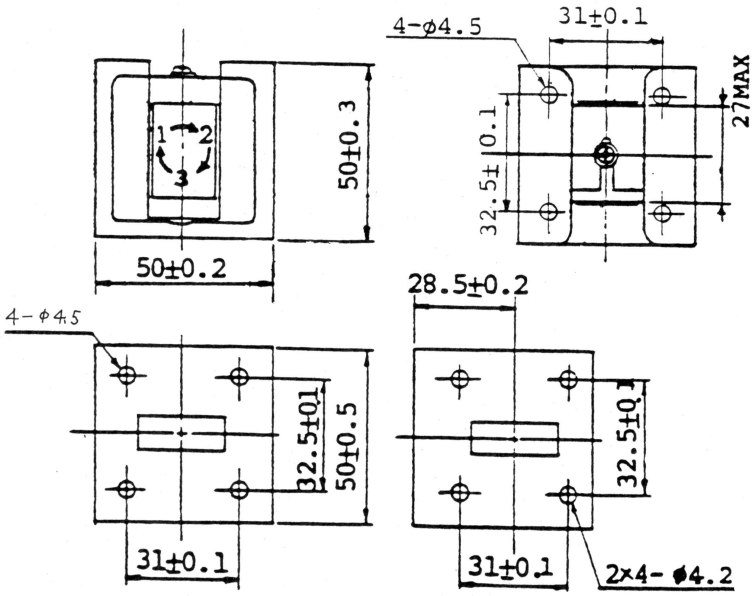
SPECIFICATIONS OF CIRCULATOR

Type:	RC-4356
Furuno Code No.:	000-106-863
Manufacturer:	Toshiba
Applications:	X-band, directional coupling

Electrical Characteristics:

Frequency Range:	9,300 to 9,500MHz
Center Frequency:	9,400MHz
Bandwidth:	200MHz
Insertion Loss (Ta=25°):	0.3dB (Max.)
Isolation(*):	29dB (Min.)
Allowable Average Power:	30W
Allowable Peak Power:	30kW
VSWR:	Less than 1.1

(*): Isolation is the ratio between the energy entering into a port and energy scattered into the adjacent port on the side opposite to normal circulation. It is measured with a matched source and all other ports correctly terminated.



Unit: mm

SPECIFICATIONS OF LIMITER

Type:	S-Lx12
Furuno Code No.:	000-107-090
Applications:	X-band limiter

Maximum Ratings at Tc=25°C

Pulse Power: (see note 1.):	800W
Average Power:	0.8W
Operating Temperature:	-20 to +70°C
Storage Temperature:	-30 to +90°C

Electrical Characteristics at Tc=25°C

	Min.	Max.	Unit
Frequency Range:(see note 2.):	9.3	9.5	GHz
Insertion Loss at 9.4GHz (see note 2.):		1.1	dB
VSWR (see note 2.):		1.5	
Flat Leakage Power (see note 3.):		120	mW
Spike Leakage Power (see note 3.):		300	mW
Recovery Period to -3dB (see note 3.):		0.5	us
Rated Power for continuous operation: (see notes 1 and 4.)		400	W

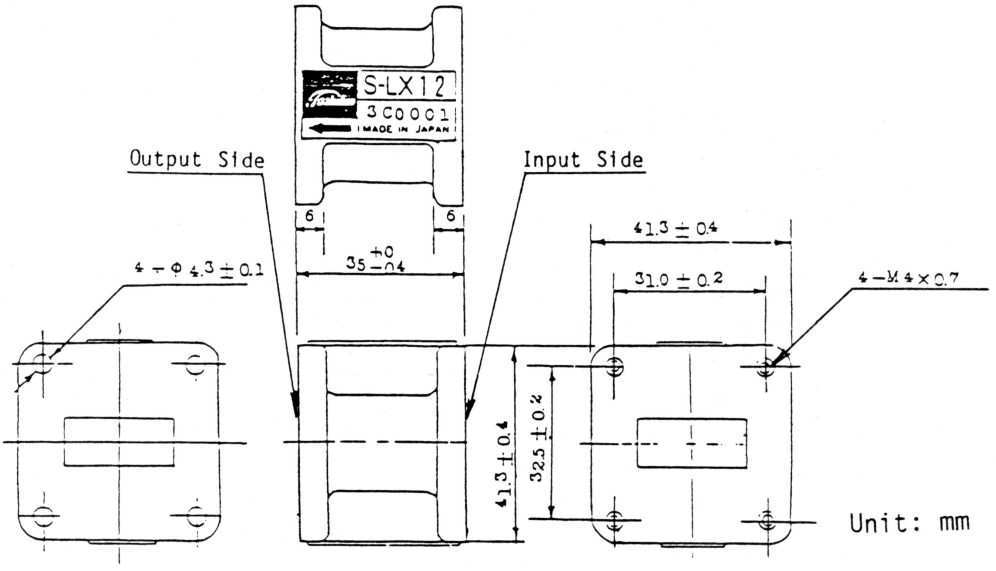
Life-over Point: When the insertion loss for 0.5mW continuous wave exceeds 3dB.

Note: 1. Measured at 9375MHz; pulselength, 1us and pulse repetition rate, 1000pps.

2. Measured at continuous wave of less than 0.5mW.

3. Measured at pulse power 400W; 9375MHz; pulselength, 1us and pulse repetition rate, 1000pps.

4. This value is subject to change with pulselength and case temperature.

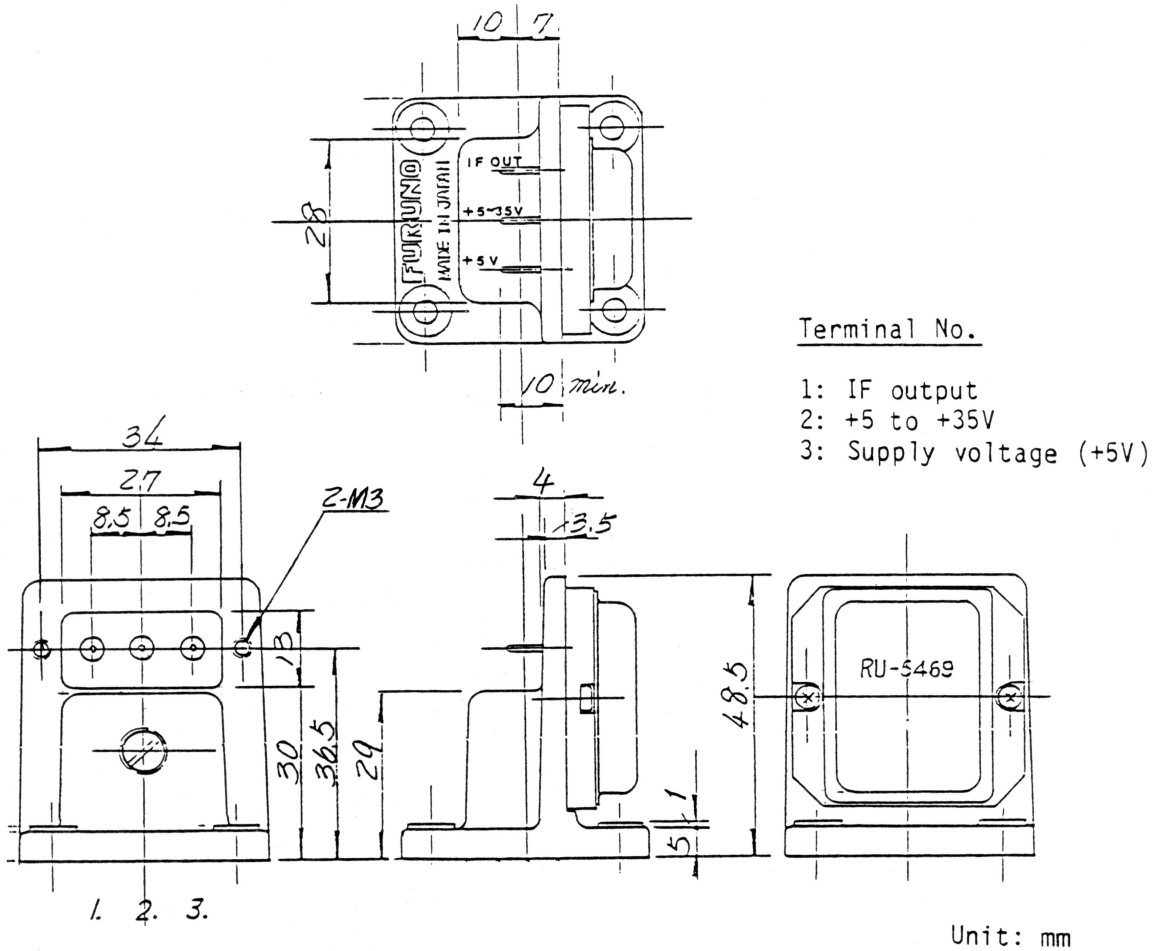


SPECIFICATIONS OF MIC

Type:	RU-5469
Furuno Code No.:	000-105-431
Manufacturer:	Fujitsu
Application:	X-band frequency conversion
Structure:	Microwave IC

Electrical Characteristics at T=25°C

Frequency range:	9,300 to 9,500MHz
Noise figure:	Less than 4.0dB
Intermediate frequency:	60MHz
Local oscillation frequency:	9,360 to 9,560MHz
Tuning sensitivity:	6MHz/V (Min.)
Total gain:	More than -7dB
Operating voltage:	+5V
Tuning voltage:	5 to 35V



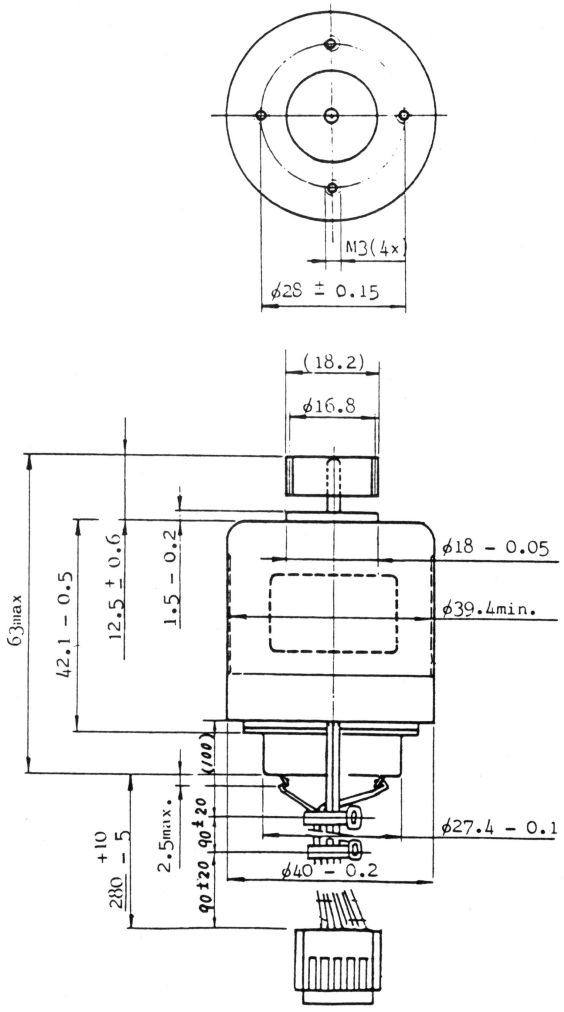
Terminal No.

1: IF output
2: +5 to +35V
3: Supply voltage (+5V)

Unit: mm

SPECIFICATIONS OF MOTOR

Type:	RM-5499
Furuno Code No.:	000-633-400
Manufacturer:	Japan Micro Motor Co., Ltd.
Rating:	Continuous
Input Voltage:	12VDC
Current:	60mA (Max.)
Number of Revolutions:	150rpm
Torque:	20gcm
Rotating Direction:	CCW viewed from axis
Ambient Temperature:	-30 to +70°C
Life of Motor:	More than 10,000 hours
Tacho-meter Output Freq.:	180Hz
Tacho-meter Output Voltage:	100mVp-p (Min.) (at 150rpm, 1000kohms load)

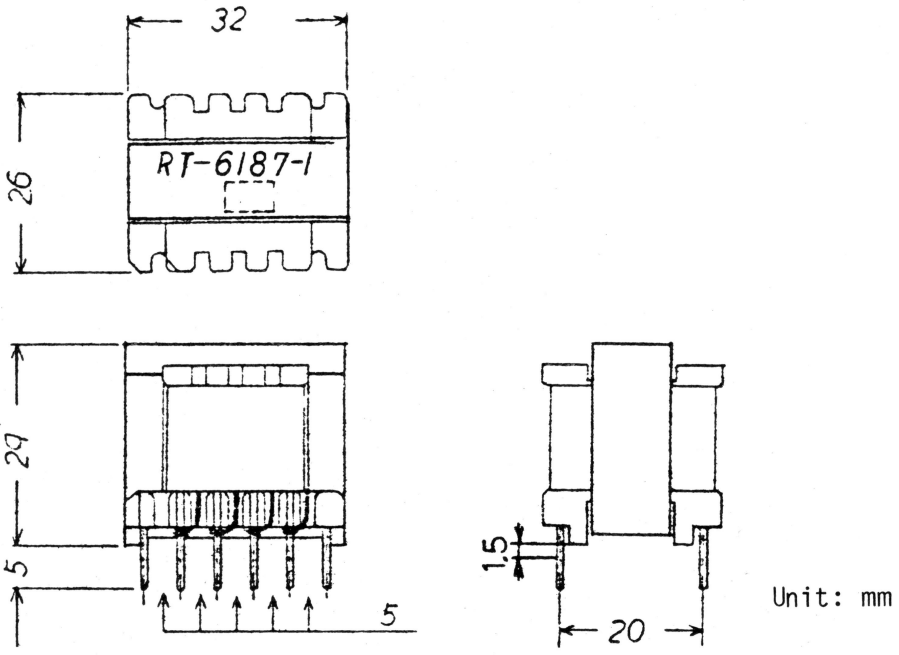


Unit: mm

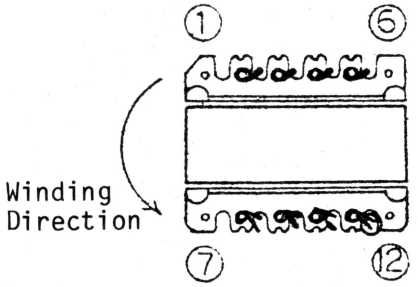
FURUNO

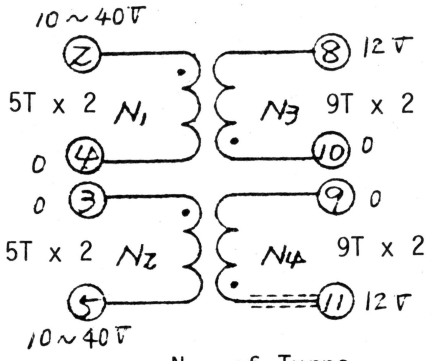
SPECIFICATIONS OF TRANSFORMERS

Type:	RT-6187-1 (Power Transformer)
FURUNO Code No.:	000-104-533
Inductance:	29.7uH (N1: ②-④) at 1kHz, 1Vrms 94uH (N3: ⑩-⑧) at 1kHz, 1Vrms
DC Resistance:	0.017ohms (N3: ⑩-⑧)
Insulation Resistance:	More than 100Mohms at 500VDC (1min.) (③-②:⑧-⑨)
Withstanding Voltage:	1000VAC (1min.) (③-②;⑧-⑨) or 1200VAC (2 to 3sec.) (③-②;⑧-⑨)



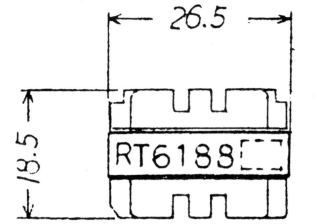
Unit: mm

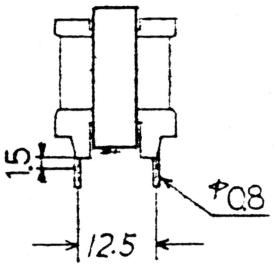




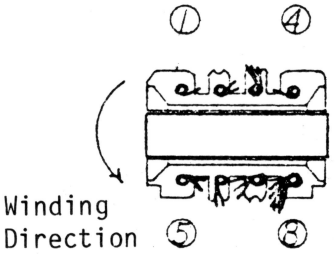
No. of Turns

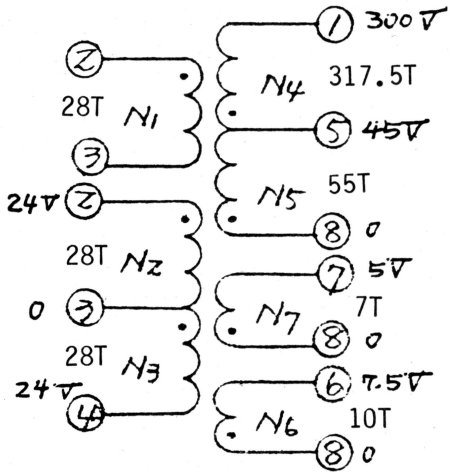
Type:	RT-6188 (Power Transformer)
FURUNO Code No.:	000-104-534
Inductance:	1.72mH (②-③) at 1kHz, 1Vrms 305mH (①-⑧) at 1kHz, 1Vrms
DC Resistance:	31.5ohms (①-⑧)
Insulation Resistance:	More than 100Mohms at 500VDC (1min.) (③-⑧)
Withstanding Voltage:	1000VAC (1min.) (③-⑧) or 1200VAC (2 to 3sec.) (③-⑧)





Unit: mm



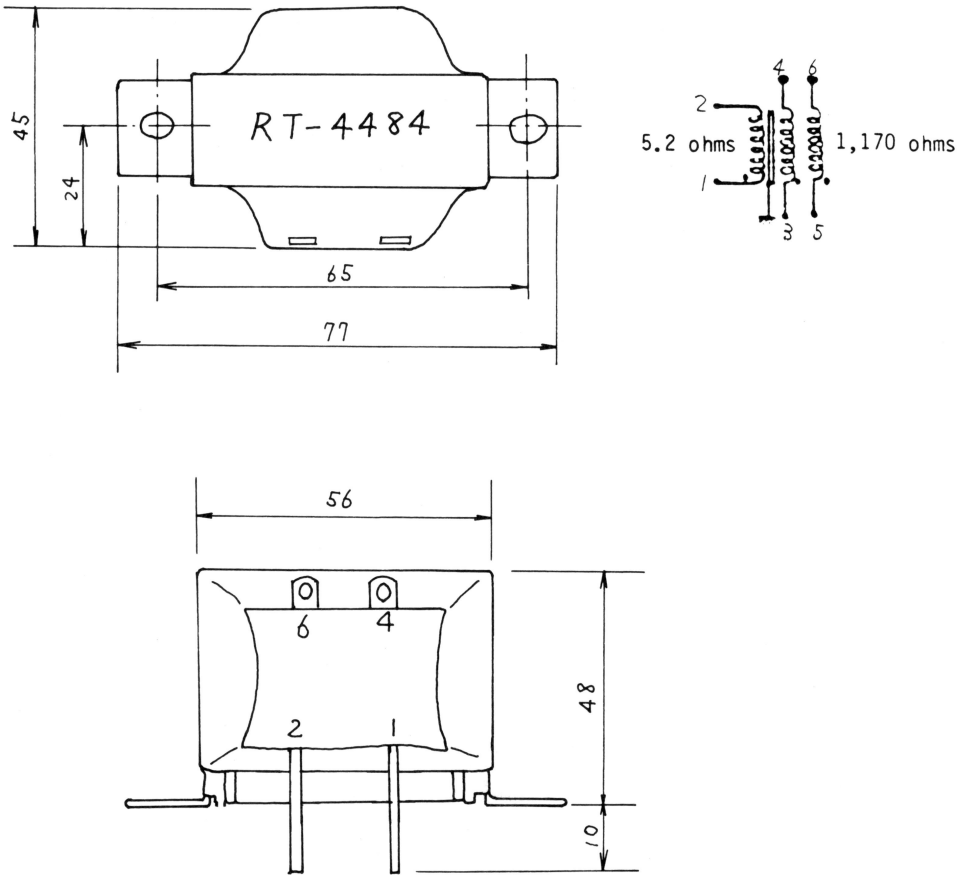


No. of Turns

Type: RT-4484 (Pulse Transformer)
Furuno Code No.: 000-734-484

Electrical Characteristics

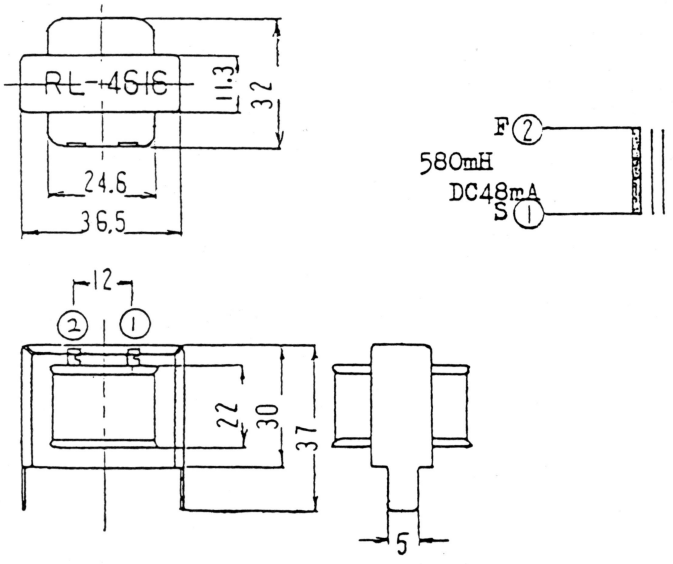
Impedance:	5.2 ohms : 1,170 ohms
Pulselength:	0.08 to 0.6us
Pulse Repetition Rate:	1,000 to 3,500Hz
Output voltage:	3.5KV
Output current:	3A
Heater current:	0.52A
Insulation resistance:	More than 100Mohms at 500VDC
Winding ratio:	1:15:15



Unit: mm

SPECIFICATIONS OF CHOKE COIL

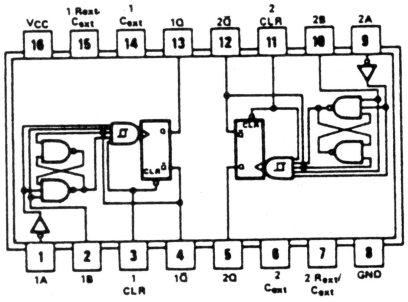
Type:	RL-4616
Furuno Code No.:	000-101-282
Inductance:	580mH (DC current: 48mA, 1.5KHz/27Vrpm)
DC resistance:	Less than 45 ohms
Insulation resistance:	More than 100M ohms
Operating temperature:	-20 to +70°C



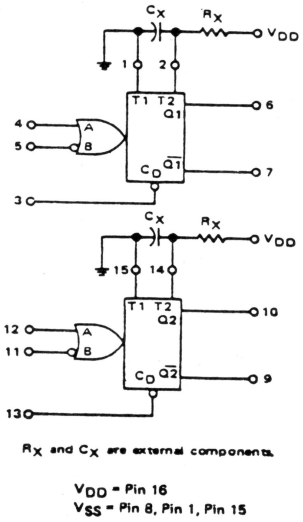
Unit: mm

SPECIFICATIONS OF DIGITAL ICs

Type	Code No.	Manufacturer	Function
HD74LS221P	000-162-530	Hitachi	Dual Monostable Multivibrator
TC4538BP	000-163-907	Toshiba	Dual Retriggerable One-shot Multivibrator



HD74LS221P



R_X and C_X are external components.

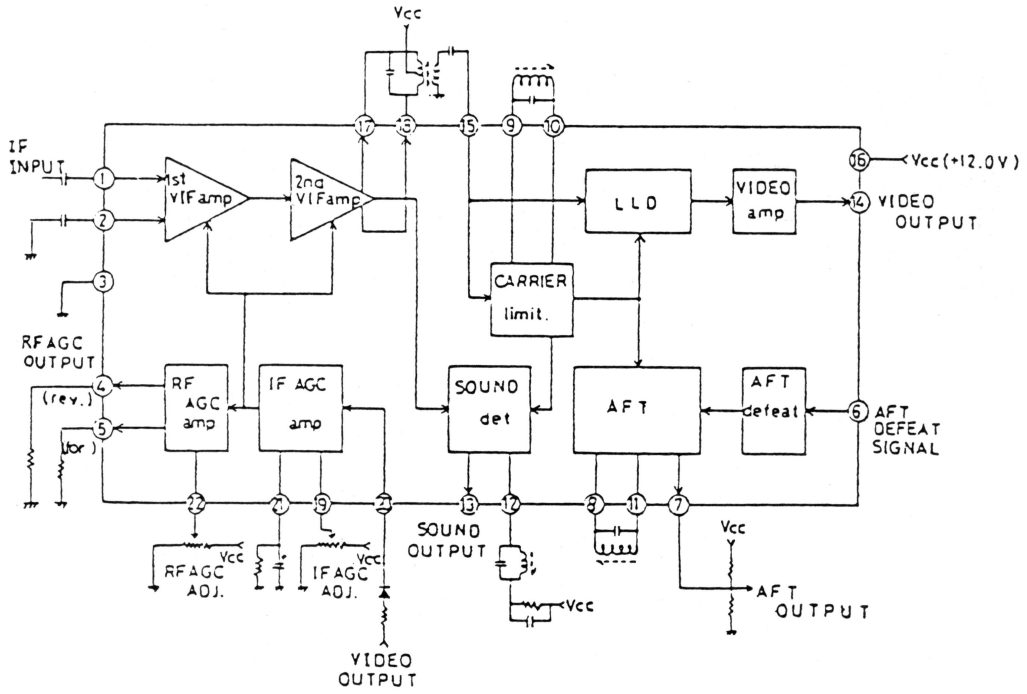
V_{DD} = Pin 16
V_{SS} = Pin 8, Pin 1, Pin 15

TC4538BP

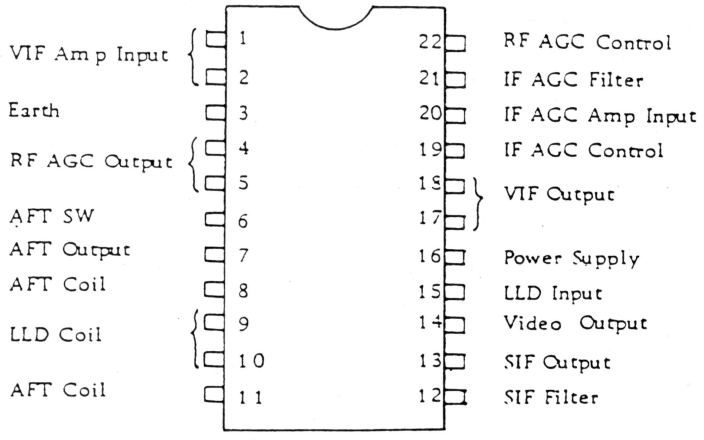
Type: M5186P
Furuno Code No.: 000-150-284
Application: TV IF Amp, Video Detector, Auto Freq. Control

Absolute Maximum Ratings (Ta = 25°C)

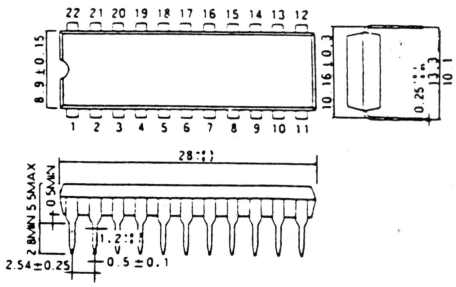
Supply Voltage: 16V
Power Dissipation: 1.4W
Operating Temperature: -20 to +75°C
Storage Temperature: -40 to +125°C



BLOCK DIAGRAM



CONNECTION DIAGRAM (TOP VIEW)



Unit: mm

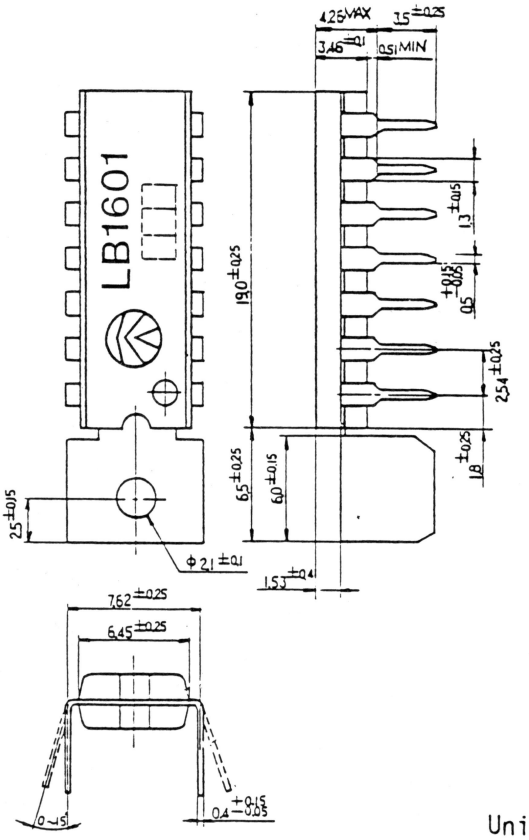
Type: LB1601
Furuno Code No.: 000-161-551
Manufacturer: Sanyo
Applications: Motor Speed Control

Maximum Ratings (Ta=25°C)

	Min.	Max.	Unit
Supply Voltage(Vcc):	-0.3	17	V
Input Voltage:	Vcc/2 - 2.5	Vcc/2 + 2.5	V
Output Voltage:	-0.3	Vcc	V
Power Dissipation:		1.3	W
Operating Temperature:	-20	+75	°C

Electrical Characteristics (Ta=25°C)

Input Bias Current:	-10	+10	uA
Input Voltage: (Vcc=5V)	2.0	3.0	V
Output Voltage:		1.0	V
Current Dissipation:		20	mA



Unit: mm

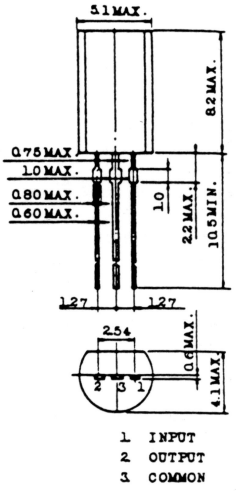
Type:	TA78L005AP
Furuno Code No.:	000-163-606
Manufacturer:	Toshiba
Application:	+5V regulator

Maximum Ratings (Ta=25°C)

Supply voltage:	35V
Output current:	150mA
Power dissipation:	800mW
Operating temperature:	-30 to 75°C

Electrical Characteristics (Tj=25°C)

Output voltage:	5V
Quiescent current:	3.1mA
Line regulation:	55mV
Load regulation:	11mV
Ripple rejection:	49dB

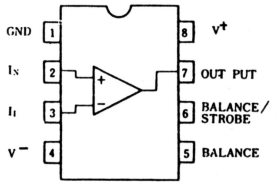


Unit: mm

Type:	uPC271C
Furuno Code No.:	000-161-050
Manufacturer:	NEC
Applications:	Comparator

Maximum Ratings (Ta=25°C)

Differential Input Voltage:	±30V
Input Voltage:	±15V
Power Dissipation:	350mW
Operating Temperature:	-20 to +70°C



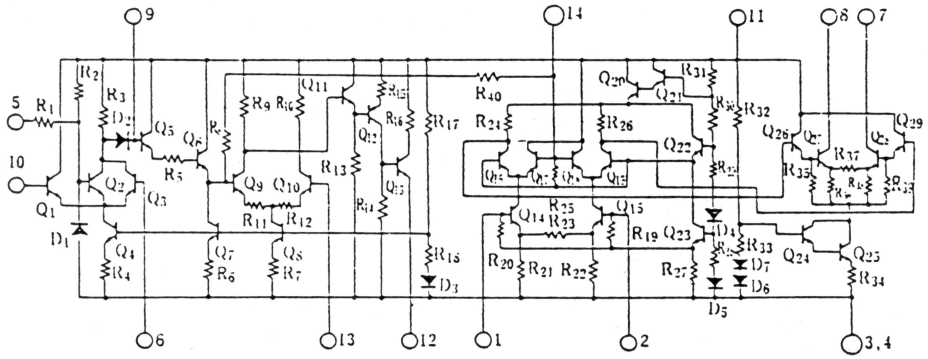
(Top View)

SPECIFICATIONS OF LINEAR ICs

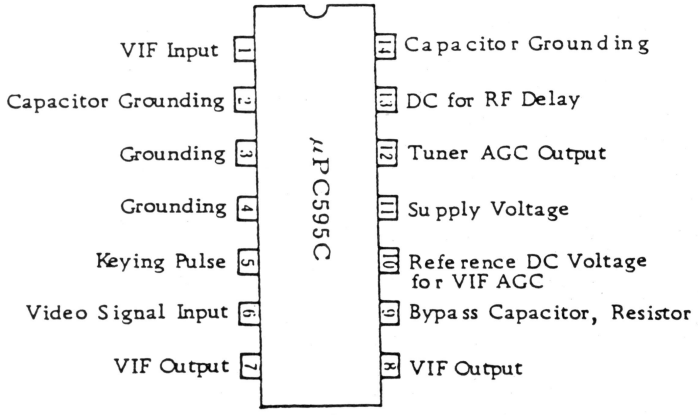
Type: μPC595C
Furuno Code No.: 000-161-060

Absolute Maximum Ratings at Ta=25°C

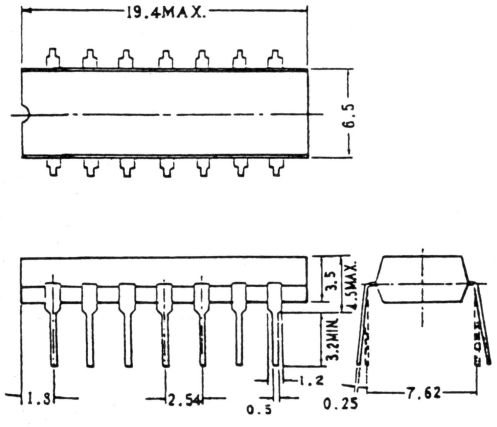
Supply voltage to pin 11	18V
Supply voltage to pins 7 and 8	18V
Input voltage between pins 1 and 2	10V
Supply voltage to pins 6 and 10	6V
Input voltage to pin 5	+10, -20V
Power consumption	400mW at Ta=70°C
Operating temperature	-20 to +70°C
Storage temperature	-40 to +125°C



EQUIVALENT CIRCUIT



CONNECTION DIAGRAM (TOP VIEW)



OUTLINE

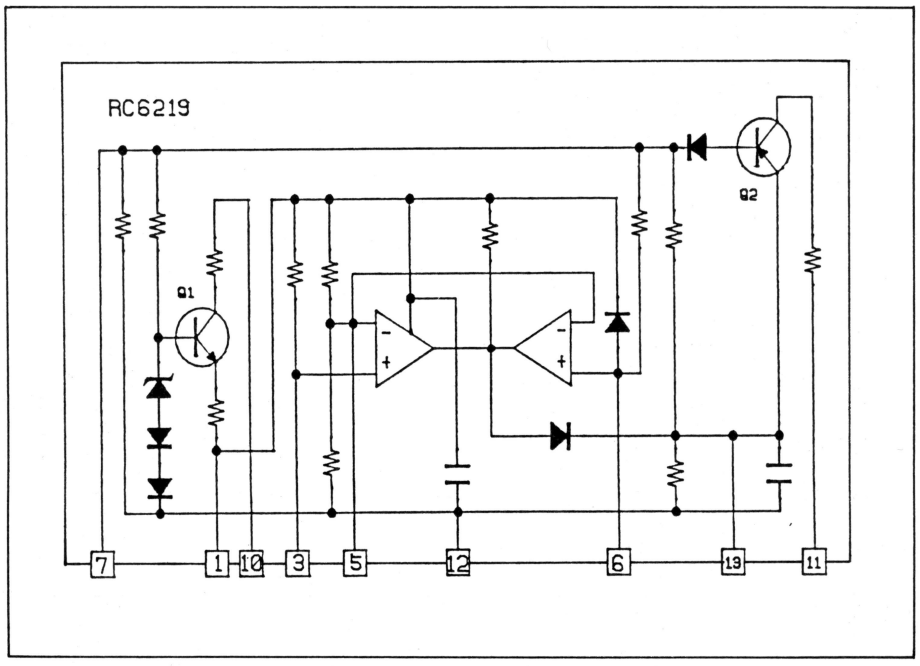
Type: RC-6219
FURUNO Code No.: 000-104-530
Manufacturer: SANYO
Application: Voltage Regulator

Maximum Ratings

	Min.	Max.	Unit
Supply Voltage (Vcc) :	8	50	V
Operating Temp. :	-20	75	°C

Electrical Characteristics

Item	Measuring point	Ratings	Measuring Conditions
Terminal Voltage	Pin#1	10 ± 0.5V	Pin#7 & #10 : 40VDC Pin#11 : 5VDC Pin#12 : GND
	Pin#5	8 ± 0.5V	
	Pin#13	4.5 ± 0.5V	Pin#3: Open, Pin#6: Open
		2.8 ± 0.3V	Pin#3: GND, Pin#6: Open
		2.8 ± 0.3V	Pin#3: Open, Pin#6: GND
		2.8 ± 0.3V	Pin#3: GND, Pin#6: GND



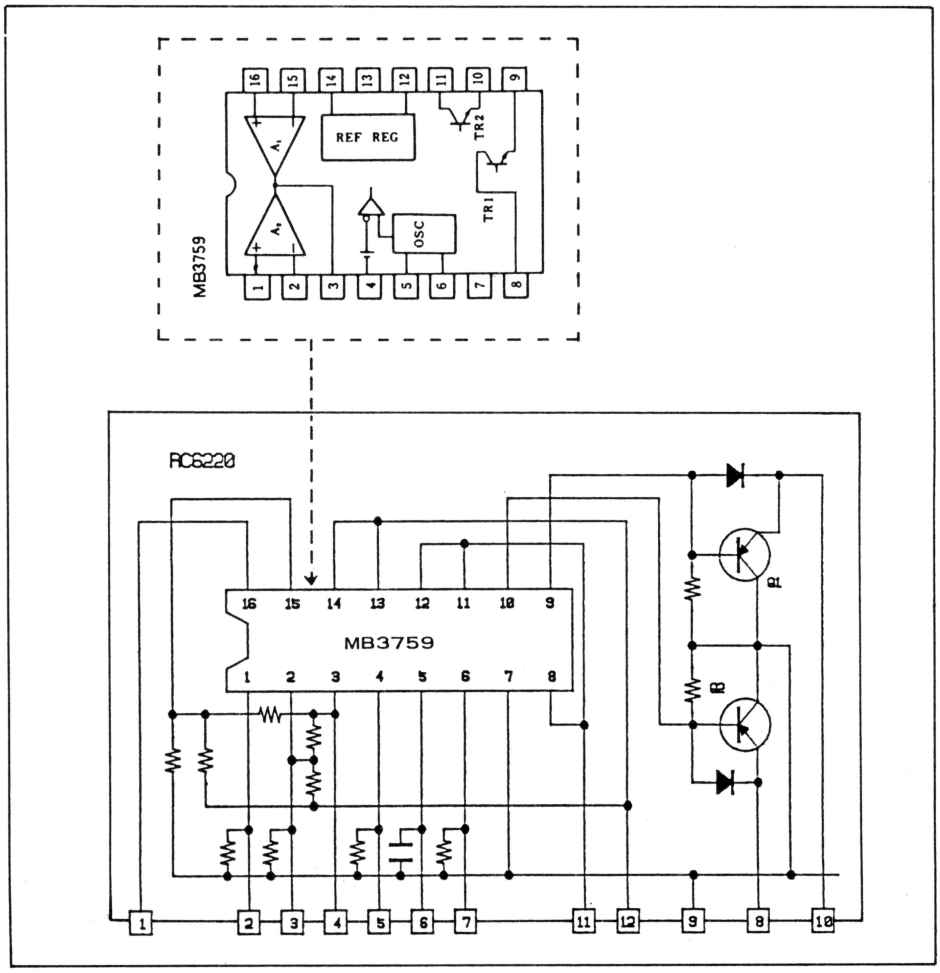
Type: RC-6220
FURUNO Code No.: 000-104-531
Manufacturer: SANYO
Application: Switching Regulator Control

Maximum Ratings

	Min.	Max.	Unit	Note
Supply Voltage (Vcc) :	8	40	V	Pin#11: Vcc, Pin#9: GND
Operating Temp. :	-20	75	°C	

Electrical Characteristics

Item	Measuring point	Ratings	Measuring Conditions
Output Frequency	Pin#10 Pin#8	90kHz ± 3%	Pin#11: 10VDC Pin#1 & #9: GND
OutPut Voltage	Pin#10	8 to 10V	Pin#11: 10VDC Pin#1 & #9: GND Pin#10 to GND: 1000pF load
	Pin#8	8 to 10V	Pin#11: 10VDC Pin#1 & #9: GND Pin#8 to GND: 1000pF laod



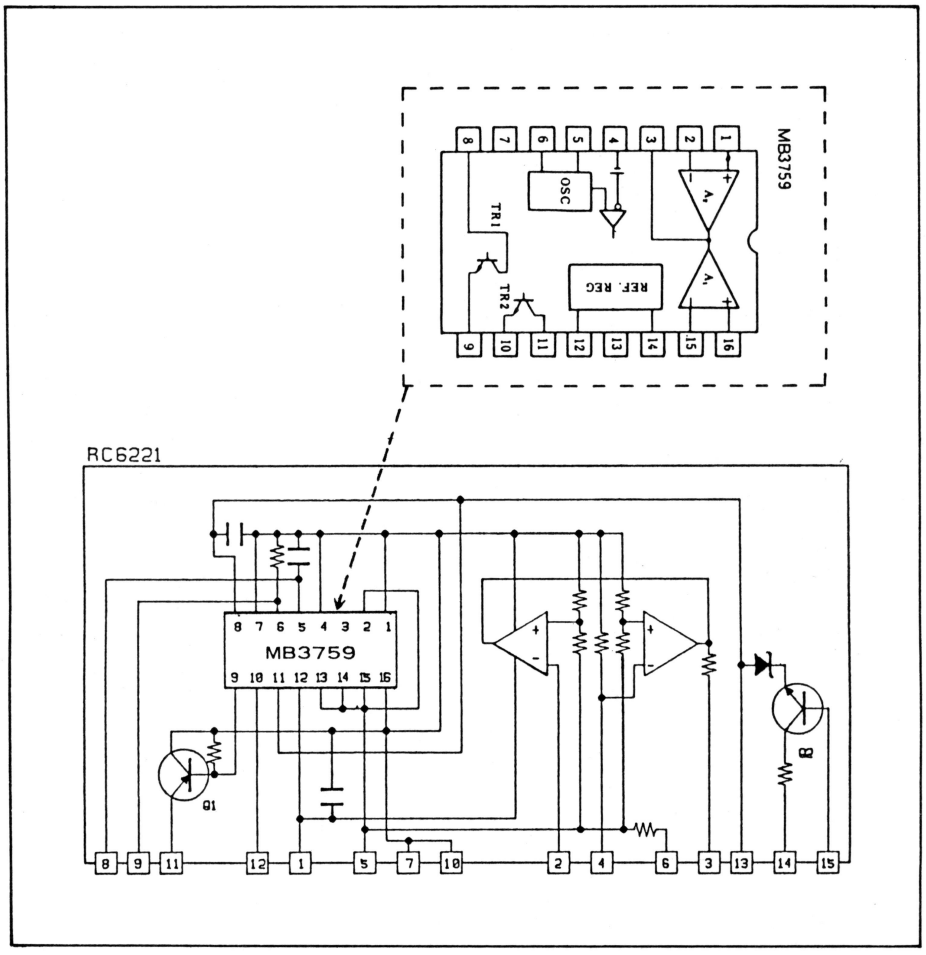
Type: RC-6221
FURUNO Code No.: 000-104-532
Manufacturer: SANYO
Application: Switching Regulator Control

Maximum Ratings

	Min.	Max.	Unit	Note
Supply Voltage (Vcc) :	8	30	V	Pin#1: Vcc, Pin#7 & #10: Vee
Operating Temp. :	-20	75	°C	

Electrical Characteristics

Item	Measuring point	Ratings	Measuring Conditions
Output Frequency	Pin#11	45kHz ± 3%	Pin#1: 12VDC Pin#7 & #10: -12VDC Pin#13: GND
OutPut Voltage	Pin#11	8 to 10V	Pin#1: 12VDC Pin#7 & #10: -12VDC Pin#13: GND Pin#11 to GND: 1000pF laod



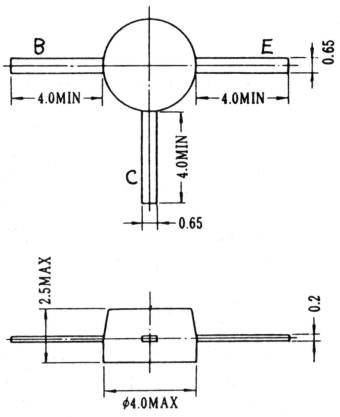
SPECIFICATIONS OF TRANSISTORS

*** TRANSISTOR ***

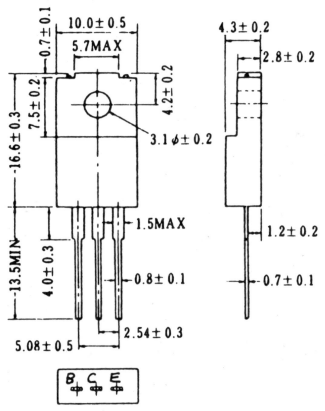
TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	ABSOLUTE MAX RATINGS AT 25°C					CHARACTERISTICS(25°C)				TO NO.	OUT-LINE	NOTE/SUBSTITUTE
					VCBO (V)	VEBO (V)	IC (MA)	PC (MW)	TJ (°C)	VCE (V)	IC (MA)	HFE	FT (MHZ)			
2SC606BT	000123915	NEC	RF	SI	30	4	20	150	150	10	2	60	530		TR-1	
2SA467GTMO	000116930	TOS	RF	SI.EP	-40	-5	-400	400	125	-1	-100	70-140	100		TR-3	COMPLEMENT.2SC367GTM-O
2SA495GTMY	000116993	TOS	RF	SI.E	-50	-5	-150	400	125	-1	-10	120-240	100		TR-3	
2SA715WTC	000117430	HTC	RF	SI.EP	-35	-5	-2.5A	10W*	150	-2	-500	100-200	160		TR-4	* AT TC=25°C
2SB941	000121302	MAT	PA	SI.EP	-60	-5	-3A	35W	150	-4	-1A	40-250			TR-2	
2SC1815-Y	000125631	TOS	AF	SI.E	60	5	150	400	125	6	2		80		TR-3	
2SC752GTMO	000124129	TOS	RF	SI.EP	40	5	200	400	125	1	100	70-140	400		TR-3	
2SC945	000124420	NEC	RF.AF	SI.E	60	5	100	250	125	6	1	200	250		TR-3	CONPLEMENT 2SA733

NOTE: VCBO=COLLECTOR-BASE VOLTAGE (EMITTER OPEN), VEBO=EMITTER-BASE VOLTAGE (COLLECTOR OPEN), IC=COLLECTOR CURRENT, PC=POWER DISSIPATION, TJ=JUNCTION TEMPERATURE, VCE=COLLECTOR-EMITTER VOLTAGE, IC=COLLECTOR CURRENT, HFE=STATIC FORWARD CURRENT TRANSFER RATIO, FT=TRANSITION FREQUENCY.

MANUFACTURER(MFR.): FJD=FUJI ELECTRIC, FUJ=FUJITSU, HTC=HITACHI, IRJ=INTERNATIONAL RECTIFIER (JAPAN), MAT=MATSUSHITA, MOT=MOTOROLA, MTB=MITSUBISHI, NEC=NIPPON ELECTRIC, NJR=NEW JAPAN RADIO, OKI=OKI ELECTRIC, ORG=ORIGIN ELECTRIC, SHP=SHARP, SKN=SANKEN ELECTRIC, SND=SHINDENGEN ELECTRIC, SON=SONY, STL=STANLEY ELECTRIC, SYO=SANYO, TOS=TOSHIBA



TR-1



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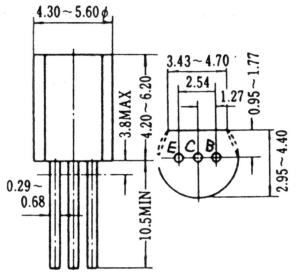

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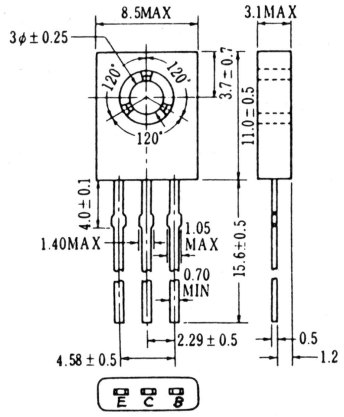
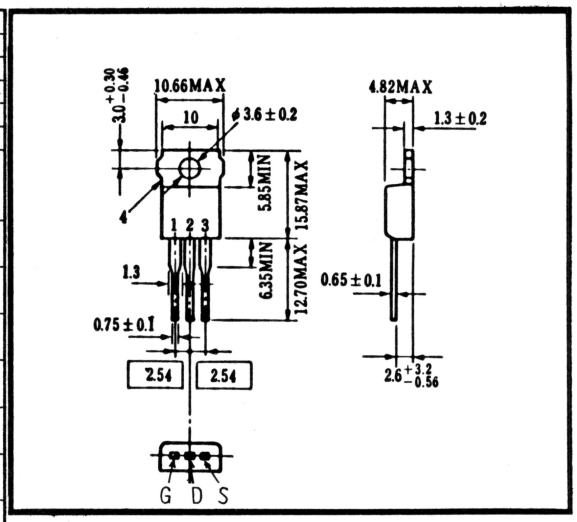


TR-4

SPECIFICATIONS OF FIELD EFFECT TRANSISTOR

Type		2SK470
Furuno Code No.		000-104-809
Manufacturer		Nichiden
Construction		MOS
Application		SW
ABSOLUTE MAXIMUM RATINGS (Ta=25°C)		
Drain-Source shorted Gate-Drain Voltage	V_{GDS}	—
Drain-Source Voltage	V_{DSS}	100V
Gate-Source Voltage	V_{GSS}	±20V
Gate Current	I_G	—
Drain Current	I_D	±8A
Power Dissipation	Pd	50W
Junction(channel) Temp	$T_{j(ch)}$	150°C
ELECTRICAL CHARACTERISTICS		
Drain Current at Gate-Source shorted	I_{DSS}	Min. Max. 50uA

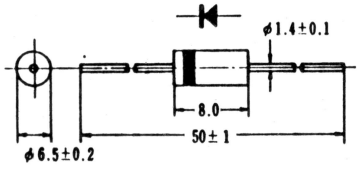


*** DIODE ***

TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	ABSOLUTE MAX RATINGS AT 25°C						FORWARD (25°C)			REVERSE(25°C)		OUT-LINE	NOTE/SUBSTITUTE
					VRM (V)	VR (V)	VI (V)	IFM (MA)	IO (MA)	IS (A)	MIN IF (MA)	VF (V)	MAX VF (V)	IF (A)	MAX IR (UA)	VR (V)		
CTG-22R	000132440	SKN	R	SI.D	200	140			10A	65			1.8	5	500	200	CR-2	
DFG1B15	000136017	HTC	R	SI.D	1500				400	30			2.5	0.4	10	1500	CR-4	
DFG1B8	000136013	HTC	R	SI.D	800				400	30			2.5	0.4	2.0	800	CR-4	
ESAC92-02	000104806	FUJ	R	SI.D	200				10A	50			0.95	5	80	200	CR-3	
RK44	000104807	SKN	R	SI.SB	40	28			1.7	60			0.55	2	5MA	40	CR-1	
SB-2	000135012	SKN	R	SI.D	500		350		1.5A*	100			1.1	1.5	10	500	CR-7	*TA=60°C/1S1897
U06C	000135901	HTC	R	SI.D	200				2A	80			1.4	2			CR-5	1S2596
V-19E	000136020	HTC	R	SI.D	400				1A	60			1.2	1	10	400	CR-4	CATHODE:BLUE
1SS16	000114001	NEC	MIX	SI.ESB	5				30		30	0.5			25	0.5	CR-8	
1S1588	000112795	TOS	SW	SI.EP	35	30		360	120	0.5			1.3	0.1	0.5	30	CR-6	
1S2095A	000113046	TOS	SW	SI.EP	75	70		750	250	1			0.65	1MA	0.1	50	CR-6	
1S2462	000113090	TOS	D	SI.PL	220	200		300	100	0.8			1	0.1	1.2	200	CR-9	
6CC13	000130317	TOS	R	SI.D	150				6A*	200*			1.2	6	1300*	150*	CR-10	

NOTE: VRM=MAXIMUM REVERSE VOLTAGE, VR=MAX DC REVERSE VOLTAGE, VI=MAX AC INPUT VOLTAGE(RMS), IFM=MAX PEAK FORWARD CURRENT, IO=MAX AVERAGE DC OUTPUT CURRENT, IS=MAX FORWARD TRANSIT CURRENT, IF=FORWARD CURRENT, VF=FORWARD VOLTAGE, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.

MANUFACTURER(MFR.): FJD=FUJI ELECTRIC, FUJ=FUJITSU, HTC=HITACHI, IRJ=INTERNATIONAL RECTIFIER (JAPAN), MAT=MATSUSHITA, MOT=MOTOROLA, MTB=MITSUBISHI, NEC=NIPPON ELECTRIC, NJR=NEW JAPAN RADIO, OKI=OKI ELECTRIC, ORG=ORIGIN ELECTRIC, SHP=SHARP, SKN=SANKEN ELECTRIC, SND=SHINDENGEN ELECTRIC, SON=SONY, STL=STANLEY ELECTRIC, SYO=SANYO, TOS=TOSHIBA



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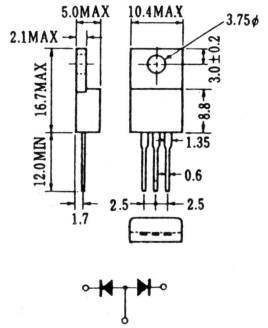

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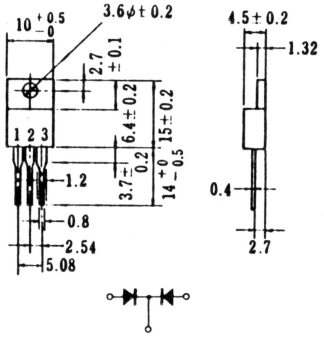

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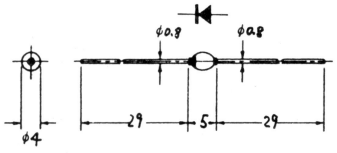

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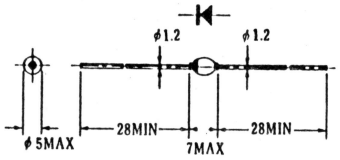

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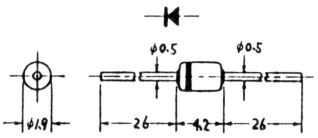

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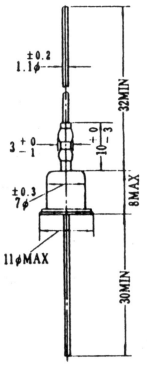

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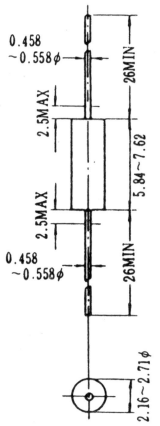

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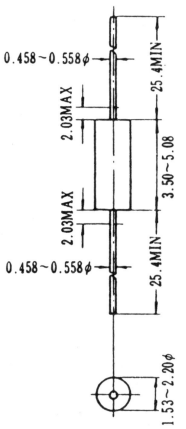


CR-9

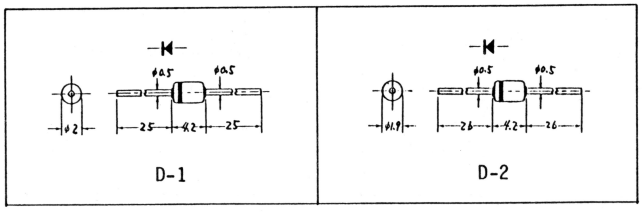
SPECIFICATIONS OF ZENER DIODES

*** ZENER DIODE ***

TYPE	CODE NO.	MFR.	APPLI-CATION	CONST-RUCTION	ABS MAX P (MW)	ABS MAX IZ (MA)	ZENER VOLTAGE VZ MIN (V)	ZENER VOLTAGE VZ AVG (V)	ZENER VOLTAGE VZ MAX (V)	IZ (MA)	MAX DYNAMIC RESISTANCE RZ (OHM)	IZ (MA)	THERMAL COEFFICIENT OF VZ (% /°C)	REVERSE (25°C) MAX IR (UA)	REVERSE (25°C) VR (V)	OUT-LINE	NOTE/SUBSTITUTE
RD33EB4	000104808	NEC		SI.PL	400		29.68		33.11	5	65	5		0.2	25	D-1	
RD39EB	000134862	NEC		SI.PL	400		34.68		38.52	5	85	5		0.2	30	D-1	
RD6.2EB1	000134833	NEC		SI.PL	400		5.8		7.0	20	20	20		5	3	D-1	
0525.1	000110804	TOS		SI.PL	500	86	4.8	5.1	5.4	5	50	5	0.030	1	1	D-2	

NOTE: P=MAXIMUM POWER DISSIPATION, IZ=ZENER CURRENT, IR=REVERSE CURRENT, VR=REVERSE VOLTAGE.

MANUFACTURER(MFR.): FJD=FUJI ELECTRIC, FUJ=FUJITSU, HTC=HITACHI, IRJ=INTERNATIONAL RECTIFIER (JAPAN), MAT=MATSUSHITA, MOT=MOTOROLA, MTB=MITSUBISHI, NEC=NIPPON ELECTRIC, NJR=NEW JAPAN RADIO, OKI=OKI ELECTRIC, ORG=ORIGIN ELECTRIC, SHP=SHARP, SKN=SANKEN ELECTRIC, SND=SHINDENGEN ELECTRIC, SON=SONY, STL=STANLEY ELECTRIC, SYO=SANYO, TOS=TOSHIBA



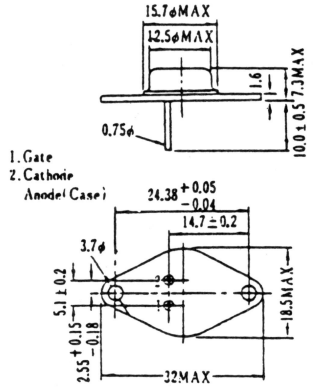
SPECIFICATIONS OF THYRISTORS (SCRs)

Type: :S6080B
Furuno Code No.: :000-135-000

Electrical Characteristics

Absolute Maximum Ratings

Repetitive Peak Off-state Volt.:	750V
Non-repetitive Peak Off-state Volt.:	800V
Repetitive Peak Reverse Volt.:	5V
On-state Current Total rms Value:	5A
On-state Current w/Alternating Comp.:	3.2A (dc value)
Surge On-state Current:	70A (60Hz)
Critical Rate of Rise of On-state Current:	200A/us
Peak Gate Power Dissipation:	25W
Average Gate Power Dissipation:	0.5W
Peak Gate Voltage:	-35V
Junction Temperature:	-40 to +100°C
Storage Temperature:	-40 to +150°C



SPECIFICATIONS OF LED

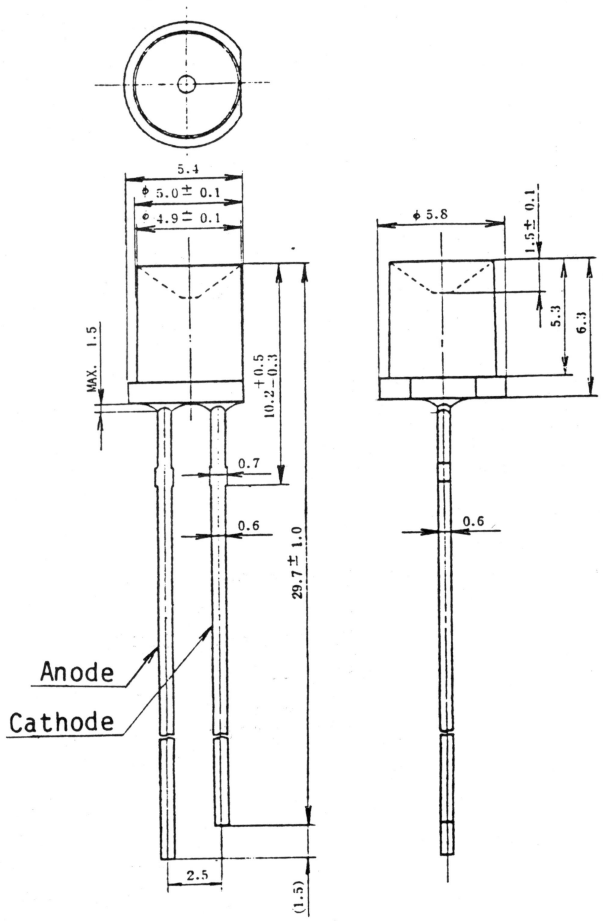
Type:	SLP-384C-51
Furuno Code No.:	000-132-875
Mnufacturer:	SANYO

Maximum Ratings

Reverse voltage:	3V
Forward current:	25mA
Operating temperature:	-25 to 80°C
Power dissipation:	70mW

Electrical Characeristics

Forward voltage:	2.1V
Reverse current:	5uA
Luminous intensity:	5.0mcd
Color:	Yellowish-green



SPECIFICATIONS OF PHOTO COUPLER

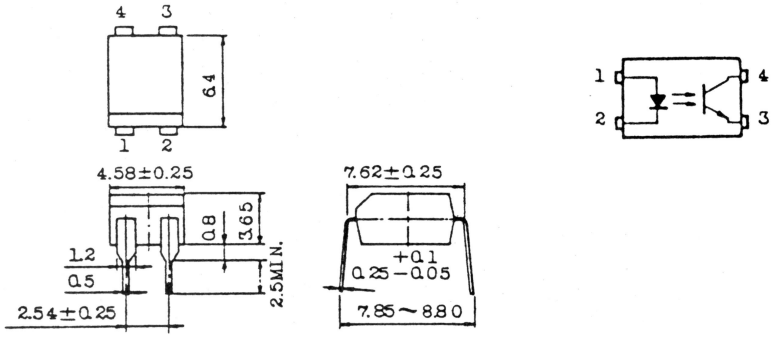
Type:	TLP521-1Y
Furuno Code No.:	000-135-866
Manufacturer:	Toshiba

Maximum Ratings at Ta=25°C

DC forward current:	50mA
DC reverse voltage:	
C-E voltage:	35V
E-C voltage:	5V
Collector current:	50mA
Operating temperature:	-30 to +100°C
Power dissipation:	150mW

Electrical Characteristics at Ta=25°C

	Min	Typ.	Max.	Unit
DC forward voltage:	1.0	1.15	1.3	V
DC reverse current:			10	uA
Inner capacitance:		30		pF



1: LED anode
2: LED cathode
4: Photo transistor emitter
3: Photo transistor collector

SYMBOL 記号		TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
		PRINTED CIRCUIT BOARD プリントキバン			
		SI-5588	312-5655	003-038-420	MOTOR CONT
		MD-4171	312-4360	003-037-550	MODULATOR
		IF-5657	312-5658	003-038-440	IF AMP
		MIC-5746	312-5746	003-038-570	
		MOTOR	モーター		
B	801	RM-5499	03S5499	000-633-400	
		CAPACITOR	コンデンサー		
C	601	DD104-69B102K50V	1000PF 50V	000-253-806	
C	607	DD104-69B102K50V	1000PF 50V	000-253-806	
C	608	DD104-69B102K50V	1000PF 50V	000-253-806	
C	609	ECC-W1H050CC	5PF 50V	000-256-450	
C	610	DD104-69B102K50V	1000PF 50V	000-253-806	
C	611	ECQ-M1H682KVW	6800PF 50V	000-260-470	
C	612	DD109-69E103P50V	0.01uF 50V	000-253-801	
C	615	ECC-W1H330JC	33PF 50V	000-256-404	
C	619	DD104-69B102K50V	1000PF 50V	000-253-806	
C	621	DD104-69B102K50V	1000PF 50V	000-253-806	
C	622	DD104-69B102K50V	1000PF 50V	000-253-806	
C	623	DD104-69B102K50V	1000PF 50V	000-253-806	
C	628	ECC-W1H150JC	15PF 50V	000-256-405	
C	633	ECC-W1H100DC	10PF 50V	000-256-410	
C	634	DD109-69E103P50V	0.01uF 50V	000-253-801	
C	635	DD104-69B102K50V	1000PF 50V	000-253-806	
C	636	DD104-69B102K50V	1000PF 50V	000-253-806	
C	637	DD104-69B102K50V	1000PF 50V	000-253-806	
C	638	DD104-69B102K50V	1000PF 50V	000-253-806	
C	639	ECE-A1CU100E	10uF 50V	000-201-672	
C	640	DD104-69B102K50V	1000PF 50V	000-253-806	
C	642	ECE-A1CU100E	10uF 50V	000-201-672	
C	643	RPE122F104Z50V	0.1uF 50V	000-251-795	
C	647	DD104-69B102K50V	1000PF 50V	000-253-806	
C	649	DD104-69B102K50V	1000PF 50V	000-253-806	
C	650	ECE-A1CU100E	10uF 16V	000-201-672	
C	651	DD104-69B102K50V	1000PF 50V	000-253-806	
C	652	DD104-69B102K50V	1000PF 50V	000-253-806	
C	654	ECQ-M1H103KVW	0.01uF 50V	000-260-416	
C	655	ECQ-M1H103KVW	0.01uF 50V	000-260-416	
C	656	ECQ-M1H562KVW	5600PF 50V	000-260-469	
C	657	ECQ-M1H152KVW	1500PF 50V	000-260-420	
C	658	ECE-A1CU100E	10uF 16V	000-201-672	
C	659	DD104-69B102K50V	1000PF 50V	000-253-806	
C	660	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	662	DD104-69B102K50V	1000PF 50V	000-253-806	
C	663	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	664	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	665	DD104-69B102K50V	1000PF 50V	000-253-806	
C	666	DD104-69B102K50V	1000PF 50V	000-253-806	
C	668	DD104-69B102K50V	1000PF 50V	000-253-806	
C	669	RPE122CH101J50	100PF 50V	000-251-859	
C	670	DD104-69B102K50V	1000PF 50V	000-253-806	
C	671	DD104-69B102K50V	1000PF 50V	000-253-806	
C	801	MD-1-2G-334K	0.33UF 400WV	000-262-089	
C	802	ECK-D3A222KB2	2200PF	000-255-750	
C	803	ECW-H06H123JD	0.012UF	000-259-529	
C	804	ECW-H06H223JD	0.022 UF	000-259-532	
C	805	ECW-H06H223JD	0.022 UF	000-259-532	
C	806	ECK-D3A392KBN	3900PF	000-255-754	
C	807	ECQ-M1H104KVW	0.1uF	000-260-411	
C	808	ECQ-M1H104KVW	0.1uF	000-260-411	
C	809	ECQ-M1H104KVW	0.1uF	000-260-411	
C	810	ECQ-M1H104KVW	0.1uF	000-260-411	
C	811	ECQ-M1H104KVW	0.1uF	000-260-411	
C	812	ECE0A1HU010E	1UF 50V	000-206-115	
C	821	RPE122CH331J50	330PF 50V	000-251-854	
C	822	ECQ-M1H102KVW	0.001UF 50V	000-260-415	
C	823	ECQ-M1H102KVW	0.001UF 50V	000-260-415	
C	824	CS99E1D6R8M3	6.8UF	000-232-060	
C	825	ECE-A1AU101E	100UF 16V	000-206-112	
C	826	ECE-A1AU101E	100UF 16V	000-206-112	
C	831	ECQ-M1H103KVW	0.01UF 50V	000-260-416	
C	851	DD104B102K50V	1000PF 50V	000-252-171	
C	852	DD106F103Z50 00S0054	0.01uF	000-253-443	
C	901	ECE-A1CU100E	10UF 16V	000-201-672	
C	902	ECEA1HSR47	0.47UF 50V	000-201-458	
C	903	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	904	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	905	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	906	ECQ-M1H273KVW	0.027uF	000-260-474	
C	907	ECQ-M1H822KVW	8200PF	000-260-471	
C	908	ECQ-M1H822KVW	8200PF	000-260-471	
C	909	RPE122F104Z50V	0.1UF 50V	000-251-795	
C	910	ECE-A1AU101E	100UF 16V	000-206-112	
C	911	DD104-69B102K50V	1000PF 50V	000-253-806	

SYMBOL 記号		TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
		DIODE	ダイオード		
CR	601	1S1588		000-112-795	
CR	602	1S1588		000-112-795	
CR	603	1S1588		000-112-795	
CR	604	1S1588		000-112-795	
CR	605	1S1588		000-112-795	
CR	606	1S1588		000-112-795	
CR	607	05Z5.1X		000-110-804	
CR	608	1S1588		000-112-795	
CR	609	1S1588		000-112-795	
CR	610	1S1588		000-112-795	
CR	612	RD39EB	ZENER	000-134-862	
CR	614	1SS16		000-114-001	
CR	810	S-LX12	03S5738	000-107-090	SEE NOTE: 1
CR	801	DFG-1B8		000-136-013	
CR	802	DFG-1B8		000-136-013	
CR	803	S6080B		000-135-000	
CR	804	SB2		000-135-012	
CR	805	1S2095A		000-113-046	
CR	806	1S1588		000-112-795	
CR	807	DFG-1B8		000-136-013	
CR	821	1S1588		000-112-795	
CR	851	RD-6.2EB	ZENER	000-134-793	
CR	901	V19E		000-136-020	
		CIRCULATOR	サーキュレータ		
HY	801	RC-4356	03S5737	000-106-863	SEE NOTE: 1
		JACK	ジャック		
J	611	B13P-SHF-1AA	13P	000-505-563	
J	612	B6P-SHF-1AA	6P	000-505-554	
J	613	B6P-SHF-1AA	6P	000-505-554	
J	801	LR-12	HOUSING	000-505-473	
		LLM-01T-2.0	CONTACT	000-505-494	
J	901	B9P-VH		000-505-827	
J	902	B10P-VH	10P	000-505-828	
J	903	B5P-SHF-1AA	5P	000-505-553	
J	904	B3P-SHF-1AA	3P	000-505-551	
		RELAY	リレー		
K	801	HC1-P-DC12V		000-454-521	
		COIL	コイル		
L	801	RL-4616	03S4616	000-101-282	
L	802	RL4584		000-734-584	
L	803	RL-3903		000-733-903	
L	804	RL-4170	12-3-4170	000-734-170	
L	851	SP0406-5R6K-6		000-429-391	
		PLUG	プラグ		
P	612	H6P-SHF-AA/6P	HOUUSING	000-505-599	
		SHF-001T-0.8BS	CONTACT	000-505-308	
		SIN-01T-1.2	BOARD-IN CONNECTOR	000-505-896	
P	904	H3P-SHF-AA/3P	HOUSING	000-505-596	
		LHF-001T-0.8BS	CONTACT	000-505-504	
		TRANSISTOR	トランジスター		
Q	601	2SC606(B)T		000-123-915	
Q	602	2SC606(B)T		000-123-915	
Q	603	2SC1815-Y		000-125-631	
Q	604	2SA495GTM-Y		000-116-993	
Q	605	2SC1315-Y		000-125-631	
Q	606	2SC1815-Y		000-125-631	
Q	607	2SC1815-Y		000-125-631	
Q	608	2SC1815-Y		000-125-631	
Q	609	2SA495GTM-Y		000-116-993	
Q	821	2SC752GTM-O		000-124-129	
Q	822	2SA715C		000-117-430	
Q	831	2SC945		000-124-420	
Q	901	2SA467GTM-O		000-116-930	

NOTE: 1. U801 is supplied with CR810 and HY801 as MIC assembly.
(Code No. 003-038-170)

備考:

SYMBOL 記号		TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
		RESISTOR	ﾃｲｺｳ		
R	603	ERD-25TJ101	0.25W 100	000-330-333	
R	604	ERD-25TJ122	0.25W 1.2K	000-330-359	
R	605	ERD-25TJ392	0.25W 3.9K	000-330-371	
R	606	ERD-25TJ472	0.25W 4.7K	000-330-373	
R	608	ERD-25TJ272	0.25W 2.7K	000-330-367	
R	609	ERD-25TJ471	0.25W 470	000-330-349	
R	610	ERD-25TJ102	0.25W 1K	000-330-357	
R	611	ERD-25TJ151	0.25W 150	000-330-337	
R	612	ERD-25TJ102	0.25W 1K	000-330-357	
R	613	ERD-25TJ821	0.25W 820	000-330-355	
R	614	ERD-25TJ332	0.25W 3.3K	000-330-369	
R	615	ERD-25TJ331	0.25W 330	000-330-345	
R	616	ERD-25TJ102	0.25W 1K	000-330-357	
R	617	ERD-25TJ331	0.25W 330	000-330-345	
R	618	ERD-25VJ471W	W5.0	000-333-465	
R	619	ERD-25VJ471W	W5.0	000-333-465	
R	620	ERD-25TJ100	0.25W 10	000-330-309	
R	621	ERD-25TJ100	0.25W 10	000-330-309	
R	622	ERD-25TJ100	0.25W 10	000-330-309	
R	623	ERD-25TJ220	0.25W 22	000-330-317	
R	624	ERD-25TJ222	0.25W 2.2K	000-330-365	
R	625	ERD-25TJ222	0.25W 2.2K	000-330-365	
R	626	ERD-25TJ105	0.25W 1M	000-330-429	
R	627	ERD-25TJ102	0.25W 1K	000-330-357	
R	628	ERD-25TJ223	0.25W 22K	000-330-389	
R	629	ERD-25TJ222	0.25W 2.2K	000-330-365	
R	630	ERD-25TJ101	0.25W 100	000-330-333	
R	631	ERD-25TJ102	0.25W 1K	000-330-357	
R	632	ERD-25TJ102	0.25W 1K	000-330-357	
R	634	ERD-25TJ103	0.25W 10K	000-330-381	
R	635	ERD-25TJ103	0.25W 10K	000-330-381	
R	636	ERD-25TJ153	0.25W 15K	000-330-385	
R	637	ERD-25TJ103	0.25W 10K	000-330-381	
R	638	ERD-25TJ102	0.25W 1K	000-330-357	
R	639	ERD-25TJ272	0.25W 2.7K	000-330-367	
R	640	ERD-25TJ183	0.25W 18K	000-330-387	
R	641	ERD-25TJ222	0.25W 2.2K	000-330-365	
R	642	ERD-25TJ271	0.25W 270	000-330-343	
R	643	ERD-25TJ100	0.25W 10	000-330-309	
R	645	ERD-25TJ104	0.25W 100K	000-330-405	
R	646	ERD-25TJ221	0.25W 220	000-330-341	
R	647	ERD-25TJ331	0.25W 330	000-330-345	
R	648	ERD-25TJ330	0.25W 33	000-330-321	
R	649	ERG-1SJ390P	00S0102-0	000-375-391	
R	650	ERD-25TJ103	0.25W 10K	000-330-381	
R	651	ERD-25TJ100	0.25W 10	000-330-309	
R	652	ERD-25TJ102	0.25W 1K	000-330-357	
R	653	ERD-25TJ104	0.25W 100K	000-330-405	
R	654	ERD-25TJ221	0.25W 220	000-330-341	
R	655	ERD-25TJ103	0.25W 10K	000-330-381	
R	656	ERD-25TJ102	0.25W 1K	000-330-357	
R	657	ERD-25TJ682	0.25W 6.8K	000-330-377	
R	658	ERD-25TJ100	0.25W 10	000-330-309	
R	801	ERG-1SJ220P	1W 22	000-375-388	
R	802	ERG-1SJ220P	1W 22	000-375-388	
R	803	ERX-2SJ3R9P	2W 3.9	000-375-443	
R	804	ERX-1SJ5R1P	1W 5.1	000-375-380	
R	805	ERX-2SJ1R0P	1W 1	000-375-436	
R	806	ERD-25TJ102	0.25W 1K	000-330-357	
R	807	ERX-2SJR62P	2W 0.62	000-100-134	
R	821	ERG-2SJ101P	2W 100	000-375-462	
R	822	ERD-25TJ102	0.25W 1K	000-330-357	
R	823	ERD-25TJ682	0.25W 6.8K	000-330-377	
R	824	ERD-25TJ102	0.25W 1K	000-330-357	
R	825	ERD-25TJ101	0.25W 100	000-330-333	
R	826	ERD-25TJ100	0.25W 10	000-330-309	
R	827	ERD-25TJ100	0.25W 10	000-330-309	
R	831	ERD-25TJ103	0.25W 10K	000-330-381	
R	832	ERD-25TJ103	0.25W 10K	000-330-381	
R	833	ERD-25TJ473	0.25W 47K	000-330-397	
R	834	ERD-25TJ223	0.25W 22K	000-330-389	
R	844	ERD-25TJ470	0.25W 47	000-330-325	
R	845	ERD-25TJ473	0.25W 47K	000-330-397	
R	901	ERD-25TJ683	0.25W 68K	000-330-401	
R	902	ERD-25TJ472	0.25W 4.7K	000-330-373	
R	903	ERD-25TJ103	0.25W 10K	000-330-381	
R	904	ERD-25TJ102	0.25W 1K	000-330-357	
R	905	ERD-25TJ331	0.25W 330	000-330-345	
R	906	ERG-1SJ470P	00S0102-0	000-375-392	
		THERMISTOR	ｻｰﾐｽﾀｰ		
RT	601	D-22A		000-180-617	
		SWITCH	ｽｲｯﾁ		
S	801	NRS-139		000-478-021	
		RP-1757 MS4X9X15		000-499-055	

SYMBOL 記号		TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
		TRANSFORMER	ﾄﾗﾝｽ		
T	601	03S5689	03S5689	000-732-801	
T	602	03S5690	03S5690	000-732-802	
T	603	03S5988	03S5988	000-101-114	
T	604	03S5692-1	03S5692-1	000-732-804	
T	605	03S5692-1	03S5692-1	000-732-804	
T	801	RT-4484		000-734-484	
		TEST POINT	ﾃｽﾄﾎﾟｲﾝﾄ		
TP	901	LC-2-S-YELLOW		000-537-970	
TP	902	LC-2-S-YELLOW		000-537-970	
TP	904	B4P-SHF-1AA	4P POST	000-505-552	
		H4P-SHF-AA,4P	HOUSING	000-505-597	
		LHF-001T-0.8BS	CONTACT	000-505-504	
		INTEGRATED CIRCUIT	ｼｲｳｾｷｶｲﾛ		
U	601	UPC595C		000-161-060	
U	602	M5186P		000-150-284	
U	603	TC4538BP	CMOS	000-163-907	
U	604	TA78L005AP		000-163-606	
U	801	RU-5469	03S5469	000-105-431	SEE NOTE: 1
U	901	LB1601	03S5742	000-161-551	
U	902	UPC271C	LINEAR	000-161-050	
		ELECTRON TUBE	ﾃﾞﾝｼｶﾝ		
V	801	9M-302/E3513,L	03S5676	000-101-733	
		POTENTIOMETER	ﾎﾟﾃﾝｼｮﾒｰﾀｰ		
VR	601	GF06U 50K	00S0087-1	000-316-799	
VR	901	RGP102-503	50K	000-316-261	

NOTE: 1. U801 is supplied with CR810 and HY801 as MIC assembly.
(Code No. 003-038-170)

備考:

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	ASSEMBLY	ｸﾐﾋﾝ		
	A1QA9DSP41	M-1700	000-104-539	CRT ASSY.
	PRINTED CIRCUIT BOARD	ﾌﾟﾘﾝﾄｷﾊﾞﾝ		
	PAN-6173	M-1700	008-330-330	ILUMMI
	PTU-6171	M-1700	008-330-360	POWER SUPP
	SPU-6172	M-1700	008-330-340	PROCESSOR
	ADJ-6175	M-1700	008-330-350	PRESET
	VOL-6174	M-1700	008-330-320	VOLUME
	MSW-6170	M-1700	008-330-310	POWER SW
	CAPACITOR	ｺﾝﾃﾞﾝｻｰ		
1B03C0001	ECE-A1CF471	470UF 16V	000-201-610	
1B03C0002	ECE-A1CF471	470UF 16V	000-201-610	
1B03C0003	ECE-A1HF221	220UF 50V	000-201-630	
1B03C0004	ECQ-M1472KZW	4700PF 100V	000-104-800	
1B03C0005	ECE-A1AF102	1000UF 10V	000-201-640	
1B03C0006	ECE-A1AU221E	220UF 10V	000-206-114	
1B03C0007	ECE-A1CF221	220UF 16V	000-104-804	
1B03C0008	ECE-A1CU221E	220MF 16V	000-201-673	
1B03C0009	MDD-2-2G-474K	0.47UF 450V	000-104-440	
1B03C0010	ECE-A2WS2R2	2.2UF 450V	000-104-805	
1B03C0011	ECE-A1HU010E	1UF 50V	000-206-115	
1B03C0012	ECE-A1CU101E	100UF 16V	000-206-112	
1B03C1301	ECQ-V1H105JZW	1UF 50V	000-104-801	
1B03C1302	ECQ-V1H105JZW	1UF 50V	000-104-801	
1B03C1303	ECQ-V1H105JZW	1UF 50V	000-104-801	
1B03C1304	ECE-A1HF221	220UF 50V	000-201-630	
1B03C1305	ECE-A1HF221	220UF 50V	000-201-630	
1B03C1306	ECE-A1HF221	220UF 50V	000-201-630	
1B03C1307	ECQ-M1472KZW	4700PF 100V	000-104-800	
1B03C1308	ECQ-M1472KZW	4700PF 100V	000-104-800	
1B03C1309	ECE-A1CU101E	100UF 16V	000-206-112	
1B03C1310	ECE-A1CU100E	10UF 16V	000-201-672	
1B03C1311	ECE-A1CU100E	10UF 16V	000-201-672	
1B03C1312	ECQ-M1H154KVW	0.15UF 50V	000-104-802	
1B03C1313	ECQ-M1H102KV	1000PF 50V	000-260-201	
1B05C0001	RPE122CH151J50	150PF 50V	000-251-853	
1B05C0001	DD308-69F104225	0.1UF 50V	000-103-771	
	DIODE	ﾀﾞｲｵｰﾄﾞ		
1B02CR0001	SLP-384C-51	LED	000-132-875	
1B02CR0002	SLP-384C-51	LED	000-132-875	
1B02CR0003	SLP-384C-51	LED	000-132-875	
1B02CR0004	SLP-384C-51	LED	000-132-875	
1B02CR0005	SLP-384C-51	LED	000-132-875	
1B03CR0001	ESAC92-02	BRIDGE	000-104-806	
1B03CR0002	CTG-22R	BRIDGE	000-132-440	
1B03CR0003	1S2095A		000-113-046	
1B03CR0004	RK44		000-104-807	
1B03CR0005	RK44		000-104-807	
1B03CR0006	RK44		000-104-807	
1B03CR0007	DFG1B15		000-136-017	
1B03CR0008	1S2462		000-113-090	
1B03CR0009	HZT-33		000-105-934	
1B03CR1301	U06C		000-135-901	
	CONNECTOR	ｺﾈｸﾀｰ		
1B01DJ0001	MCP-24F02		000-500-161	
	MCP-24S6		000-500-169	
	MCP-F102R		000-500-163	20PCS
	CONNECTOR	ｺﾈｸﾀ		
1B01DP0001	MCP-24M02		000-500-160	
	MC-24WS2		000-500-150	
	MCP-M102R		000-500-162	
	FUSE	ﾋｭｰｽﾞ		
1B03F1351	FGMB 10A AC125V		000-104-815	
	JACK	ｼﾞｬｯｸ		
1B03J0001	B7P-VH	7P	000-505-825	
1B03J0002	B4P-SHF-1AA-K	4P	000-100-573	
1B03J0003	B2P-VH	2P	000-505-820	
1B03J1301	B3P-SHF-1AA-K	3P	000-100-572	
1B03J1302	BS3P-SHF-1AA-K	3P	000-100-601	
1B03J1351	FM-142S		000-511-403	
1B06J0011	BS3P-SHF-1AA-K	3P	000-100-601	

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	COIL	ｺｲﾙ		
1B03L0001	HP032	03S6315	000-104-535	
1B03L0002	HP032	03S6315	000-104-535	
1B03L0003	SN-3-205	04S4156-0	000-103-758	
1B03L0004	SN-3-205	04S4156-0	000-103-758	
1B03L0005	SN-3-205	04S4156-0	000-103-758	
1B03L0006	FL7H-222J		000-104-457	
1B03L1301	SC-05-10J	03S6316-0	000-104-536	
	PLUG	ﾌﾟﾗｸﾞ		
1B01P0002	VHR-7N		000-505-891	
	BVH-21T-P1.1		000-100-049	7PCS
1B01P0003	H4P-SHF-AA,4P		000-505-597	
	LHF-001T-0.8BS		000-505-504	4PCS
1B01P0004	VHR-2N		000-505-885	
	BVH-21T-P1.1		000-100-049	2PCS
1B01P0051	VHR-7N		000-505-891	
	BVH-21T-P1.1		000-100-049	7PCS
1B01P0052	H13P-SHF-AA,13P	NH HOUSING	000-505-610	
	LHF-001T-0.8BS		000-505-504	13PCS
1B01P1351	FM-142P		000-511-406	
1B02P0011	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-0.8BS		000-505-504	2PCS
1B05P0055	H9P-SHF-AA,9P	NH HOUSING	000-505-602	
	LHF-001T-0.8BS		000-505-504	9PCS
1B06P0054	H10P-SHF-AA,10P	NH HOUSING	000-505-603	
	LHF-001T-0.8BS		000-505-504	10PCS
1B07P1301	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
1B07P1302	H3P-SHF-AA,3P	NH HOUSING	000-505-596	
	LHF-001T-0.8BS		000-505-504	2PCS
	TRANSISTOR	ﾄﾗﾝｼﾞｽﾀｰ		
1B03Q0001	2SK470		000-104-809	
1B03Q1301	2SK470		000-104-809	
1B03Q1302	2SK470		000-104-809	
1B03Q1303	2SK470		000-104-809	
1B03Q1304	2SK470		000-104-809	
1B03Q1305	2SB941AP		000-121-302	
	RESISTOR	ﾃｲｺｳ		
1B03R0001	ERX-1SJR68P	00S0102-0	000-375-369	
1B03R0002	ERD-25TJ270	0.25W 27	000-330-319	
1B03R0003	ERD-25TJ821	0.25W 820	000-330-355	
1B03R0004	ERD-25TJ102	0.25W 1K	000-330-357	
1B03R0005	LF14100F	00S0096-0	000-373-601	
1B03R0006	RW-1 0.1OHM J		000-104-811	
1B03R0007	ERG-2SJ150P	00S0102-0	000-375-451	
1B03R0008	ERX-1SJ1R0P	00S0102-0	000-375-371	
1B03R0009	ERG-1SJ563P	1W 5.6K	000-104-812	
1B03R0010	ERG-1SJ563P	1W 5.6K	000-104-812	
1B03R0011	ERD-25TJ332	0.25W 3.3K	000-330-369	
1B03R1301	LF14SR1G		000-104-813	
1B03R1302	LF14SR1G		000-104-813	
1B03R1303	ERG-2SJ150P	00S0102-0	000-375-451	
1B03R1304	ERG-2SJ150P	00S0102-0	000-375-451	
1B05R0001	ERD-25TJ222	0.25W 2.2K	000-330-365	
1B05R0002	ERD-25TJ152	0.25W 1.5K	000-330-361	
1B06R0001	ERD-25TJ103	0.25W 10K	000-330-381	
1B06R0002	ERD-25TJ222	0.25W 2.2K	000-330-365	
	SWITCH	ｽｲｯﾁ		
1B01S0001	03S6282-0	FKB-6282	000-104-540	TOUCHPAD
	03S6282-0	FKB-6282	000-104-540	KEY
1B07S0401	SPEA12	03S6232	000-104-814	
	TRANSFORMER	ﾄﾗﾝｽ		
1B03T0001	RT6187-1	03S6187-1	000-104-533	
1B03T0002	RT6188	03S6188	000-104-534	
	TEST POINT	ﾃｽﾄﾎﾟｲﾝﾄ		
1B03TP0301	BS6P-SHF-1AA-K	13-3-3809-1	000-100-604	
	H6P-SHF-AA,6P		000-505-599	
	LHF-001T-0.8BS		000-505-504	2PCS

NOTE:
備考:

SYMBOL 記号	TYPE 型名	SPECIFICATIONS 規格	CODE NO. コード番号	REMARKS 備考
	INTEGRATED CIRCUIT	ｼｭｳｾｷｶｲﾛ		
1B03U0001	TLP521-1Y		000-135-834	
1B03U0002	TLP521-1Y		000-135-834	
1B03U0003	TLP521-1Y		000-135-834	
1B03U0004	RC6221	03S6221	000-104-532	
1B03U1301	RC-6219	03S6219	000-104-530	
1B03U1302	RC-6220	03S6220	000-104-531	
1B05U0001	HD74LS221P		000-162-530	
	POTENTIOMETER	ﾎﾟﾃﾝｼｮﾒｰﾀｰ		
1B03VR0001	EVM-MWGA01B52	00S0119-0	000-103-646	
1B05VR0001	EVM-MWGA01B53		000-103-649	
1B05VR0002	RV-4269	20K x 2	000-319-062	
1B05VR0003	EVM-MWGA01B14		000-103-594	
1B05VR0004	EVM-MWGA01B14		000-103-594	
1B06VR0401	RK9A18027A-B2K	2KB	000-104-537	
1B06VR0601	RK9A18027A-B2K	2KB	000-104-537	
1B06VR0602	RK9A18027A-B5K	5KB	000-104-538	
	FUSE HOLDER	ﾋｭｰｽﾞ ﾎﾙﾀﾞｰ		
1B03XF1352	FH043	LC-90	000-103-164	

NOTE:
備考:

SYMBOL 記号	PARTS NAME 部品名	TYPE/DWG. NO. 型名/図番	CODE NO. コード番号	REMARKS 備考
A 100A	COMPLETE ANTENNA UNIT	RSB-0016	000-083-711	
A 110A	RADOME UPPER ASSEMBLY		008-330-380	
A 120A	RADOME LOWER ASSEMBLY		008-330-390	
A 121	RADOME BASE		100-030-220	A 120A RADOME LOWER ASSEMBLY
A 122	PACKING FOR RADOME	03-009-3204-0	100-030-230	
A 123	FIXING BOSS	03-009-3202-0	300-932-020	
A 124	SPONGE RUBBER GASKET	03-009-3205-0	300-932-050	
A 125	GASKET	03-009-3215-0	300-932-150	
A 126	GASKET	03-009-3215-0	300-932-150	
A 127	DRAIN TUBE	03-003-3001-0	300-330-010	
A 128	PACKING FOR DRAIN TUBE	03-009-3221-0	100-004-560	
A 129	SEAL WASHER	03-009-3219-0	100-004-550	
A 131	PEDESTAL	03-009-3210-0	300-932-100	
A 132	FIXING PLATE	03-009-3213-0	300-932-130	
A 133	PACKING FOR PEDESTAL	03-009-3217-0	300-932-170	
A 134	PACKING FOR PEDESTAL	03-009-3217-0	300-932-170	
A 140A	ROTARY JOINT ASSEMBLY		003-038-550	
A 151	RJ FIXING PLATE	03-009-3301-0	300-933-010	
A 152	GEAR FIXING DISK	03-009-3305-0	300-933-050	
A 153	BEARING	6006ZZ PS2	000-873-233	
A 154	BEARING COLLAR	03-009-3302-0	300-933-020	
A 155	BEARING	6906ZZ PS2	000-873-528	
A 156	BEARING NUT	03-009-3303-0	300-933-030	
A 157	COLLAR	03-009-3321-0	300-933-210	
	COLLAR	03-009-3322-0	300-933-220	
	COLLAR	03-009-3323-0	300-933-230	
A 158	IDLE GEAR	03-009-3304-1	300-933-041	
A 159	SHORT PLATE	03-009-3309-0	300-933-090	
A 161	MOTOR FIXING PLATE	03-009-3308-0	300-933-080	
A 162	BALANCER	03-009-3311-0	300-933-110	
A 163	RADIATOR MOUNT	03-009-3306-0	300-933-060	
A 164	MAGNET MOUNTING PLATE	03-009-3307-0	300-933-070	
A 165	MAGNET	RP-1757 MS4X9X15	000-499-055	
A 170A	ANTENNA RADIATOR ASSEMBLY		003-038-540	
A 181	RF CHASSIS	03-013-5301-0	301-353-010	
A 182	ADAPTOR	03-013-5302-0	301-353-020	
A 183	REED SWITCH FIXING PLATE	03-013-5303-1	301-353-031	
A 185	SHIELD COVER	03-013-5305-1	301-353-051	
A 186	SHIELD COVER	03-013-5305-1	301-353-051	
BT 101	FIXING BOLT	03-009-3203-0	300-932-030	

NOTE:
備考:

SYMBOL 記 号	PARTS NAME 部 品 名	TYPE／DWG. NO. 型名／図 番	CODE NO. コード番号	REMARKS 備 考
A-301	COVER ASSY.		008-330-270	
A-302	HOOD ASSY.		008-330-300	
A-303	KNOB	03-016-1203-0	000-104-541	
A-304	SWITCH CAP	03-016-1207-0	100-030-140	
A-305	FRONT PANEL ASSY.		008-330-280	
A-306	KNOB BOLT	KG-B3 M8x25	000-800-554	
A-307	KNOB WASHER	8.2x30.0x1.0t SUS304	000-800-486	
A-308	BRACKET ASSY		008-330-290	

NOTE:
備 考:

CONTENTS OF SCHEMATIC DIAGRAMS

Name	Dwg. No.	Page
1. INTERCONNECTION DIAGRAM	C3289-001	S-1
2. SCANNER UNIT	C3289-009	S-2
3. IF AMPLIFIER (IF-5657)	C3289-010	S-3
4. DISPLAY UNIT	C3289-014	S-4
5. POWER SUPPLY (PTU-6171)	C3289-008	S-5

* The following schematic diagrams are not contained in this service manual.

  1. PROCESSOR BOARD (SPU-6172)
  2. CRT DEFLECTION BOARD

CONTENTS OF MECHANICAL PARTS EXPLODED VIEWS

Name	Dwg. No.	Page
1. SCANNER UNIT	C3289-013	D-1
2. DISPLAY UNIT	C3289-015	D-2

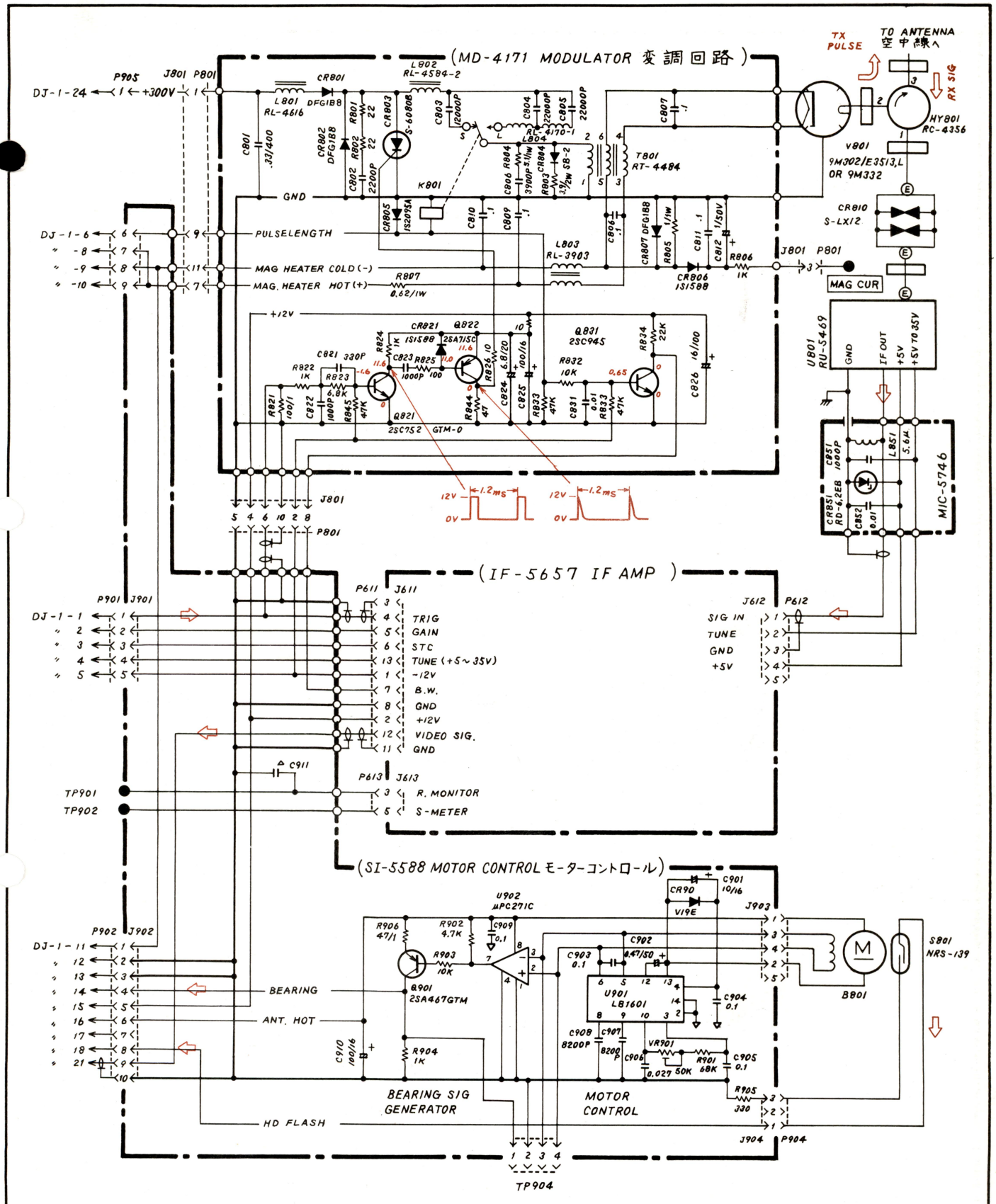
NOTE: 1. ケーブルのカラーコードで( )は内側ケーブルを示す。
WIRE COLOR CODE ( ): INNER WIRES, (B): BIG WIRES.
2. 空中線部側のシールドは完全にアースすること。
SHIELD SHOULD BE EFFECTIVELY GROUNDED AT SCANNER UNIT.
3. コネクタープラグ取付済。 CONNECTOR PLUGS FACTORY-WIRED.
4. シールドはコネクターケースを通してアースされている。
SHIELD GROUNDED THRU CONNECTOR CASE.
5. ※ 造船所支給 SHIPYARD SUPPLY.

承認 APPROVED			
検図 CHECKED	Sept. 3. '85 K. Kawamura		
製図 DRAWN	SEPT. 3. '85		
MODEL 1700			
品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG. NO.	備考 REMARKS
重量 WEIGHT kg	尺度 SCALE /	第三角法 THIRD ANGLE PROJECTION			
名称 TITLE	相互結線図 INTERCONNECTION DIAGRAM				
図番 DWG. NO.	C3289-001-A				

FURUNO ELECTRIC CO., LTD.

FURUNO

S - 1

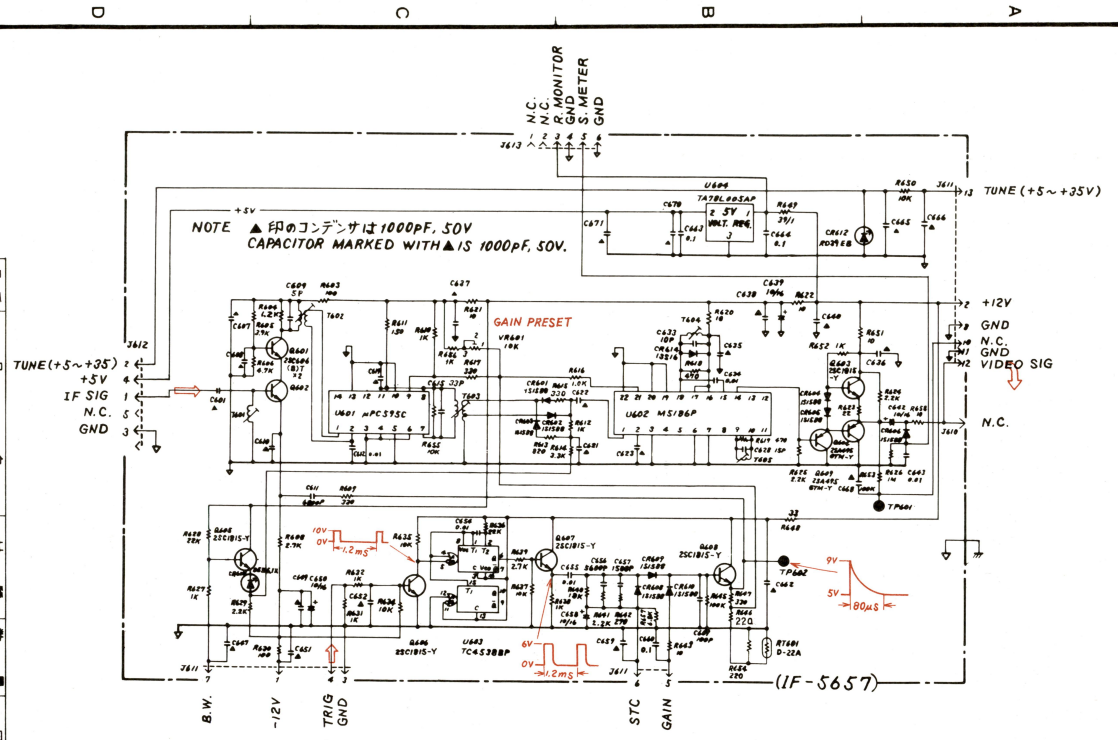


NOTE 1. 特記無き抵抗の単位は全てΩ, 1/4W ヌ コンデンサはμF.
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
2. DC電圧値はGAIN, STC共に最大 ST-BY/ショートレンジで測定。
DC VOLTAGES ARE MEASURED WITH GAIN MAX & STC MAX ON ST-BY/SHORT RANGE.
3. 波形図はGAIN, STC共に最大, 送信/3マイル レンジで測定。
WAVEFORMS ARE MEASURED WITH GAIN MAX & STC MAX ON TX/3 MILE RANGE.

名称 TITLE	空中線部回路図 SCANNER UNIT
図番 DWG. NO.	C3289-009-B

MODEL 1700

FURUNO



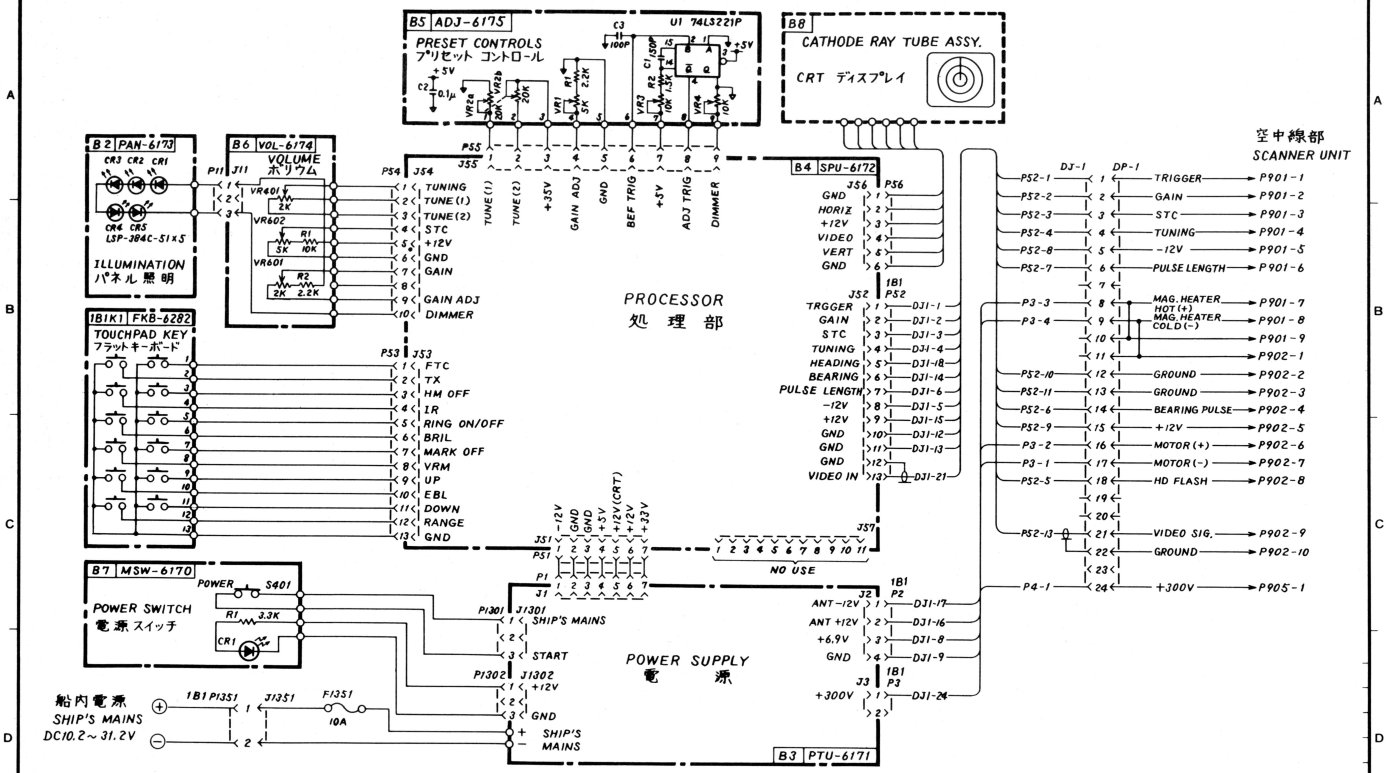
NOTE 1. 特記無き抵抗の単位は全て Ω, 1/4W スコンデンサは μF.
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.
2. DC 電圧値は GAIN, STC 共に最大, ST-BY/ショートレンジで測定。
DC VOLTAGES ARE MEASURED WITH GAIN MAX & STC MAX ON ST-BY/SHORT RANGE.
3. 波形図は GAIN, STC 共に最大, 送信/3マイルレンジで測定。
WAVEFORMS ARE MEASURED WITH GAIN MAX & STC MAX ON TX/3 MILE RANGE.

承 APPROVED	検 CHECKED	製 DRAWN	MODEL 1700	品 ITEM	品 NAME 名	材 MATERIAL	数 Q'TY	図 DWG.NO.	摘 REMARKS
図	図	図		重 WEIGHT	尺 SCALE 度	三角法 THIRD ANGLE PROJECTION			
Nov.31.'85	Nov.29.'85	Nov.28.'85		kg				図 DWG.NO. C3289-010-A	名 TITLE 称 IF-5657 IF AMPLIFIER IF アンプ

FURUNO ELECTRIC CO., LTD.

S - 3

FURUNO



ITEM 品番	NAME 品名	MATERIAL 材質	Q'TY 数量	DWG.NO. 図番	REMARKS 摘要

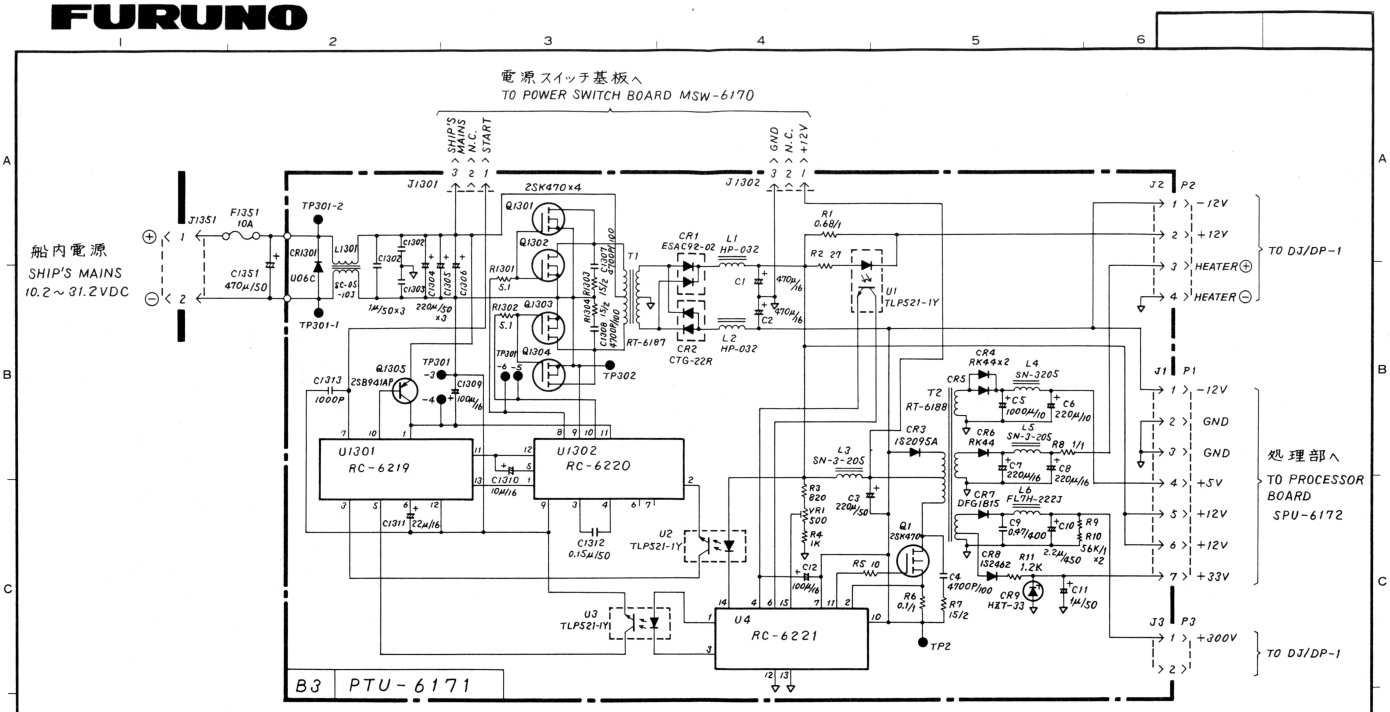
APPROVED 承認	OCT.-12.'85	THIRD ANGLE PROJECTION 三角法	TITLE 名称 指示部回路図 DISPLAY UNIT
CHECKED 検図	Oct. 12. '85	SCALE 尺度	
DRAWN 製図	OCT. 8. '85	WEIGHT 重量 kg	DWG.NO. 図番 C3289-014-B

MODEL 1700

FURUNO ELECTRIC CO., LTD.

S-4

FURUNO



NOTE 1. 特記無き抵抗の単位は全てΩ, 1/4W又コンデンサはμF。
ALL RESISTANCE IN OHMS, 1/4W AND CAPACITANCE IN MICROFARADS UNLESS NOTED OTHERWISE.

品番 ITEM	品名 NAME	材質 MATERIAL	数量 Q'TY	図番 DWG.NO.	摘要 REMARKS

承認 APPROVED	OCT. 12. '85	三角法 THIRD ANGLE PROJECTION	名称 TITLE: PTU-6171 電源部 POWER SUPPLY
検図 CHECKED	Oct. 12. '85	尺度 SCALE	
製図 DRAWN	OCT. 8. '85	重量 WEIGHT kg	図番 DWG.NO. C3289-008-D

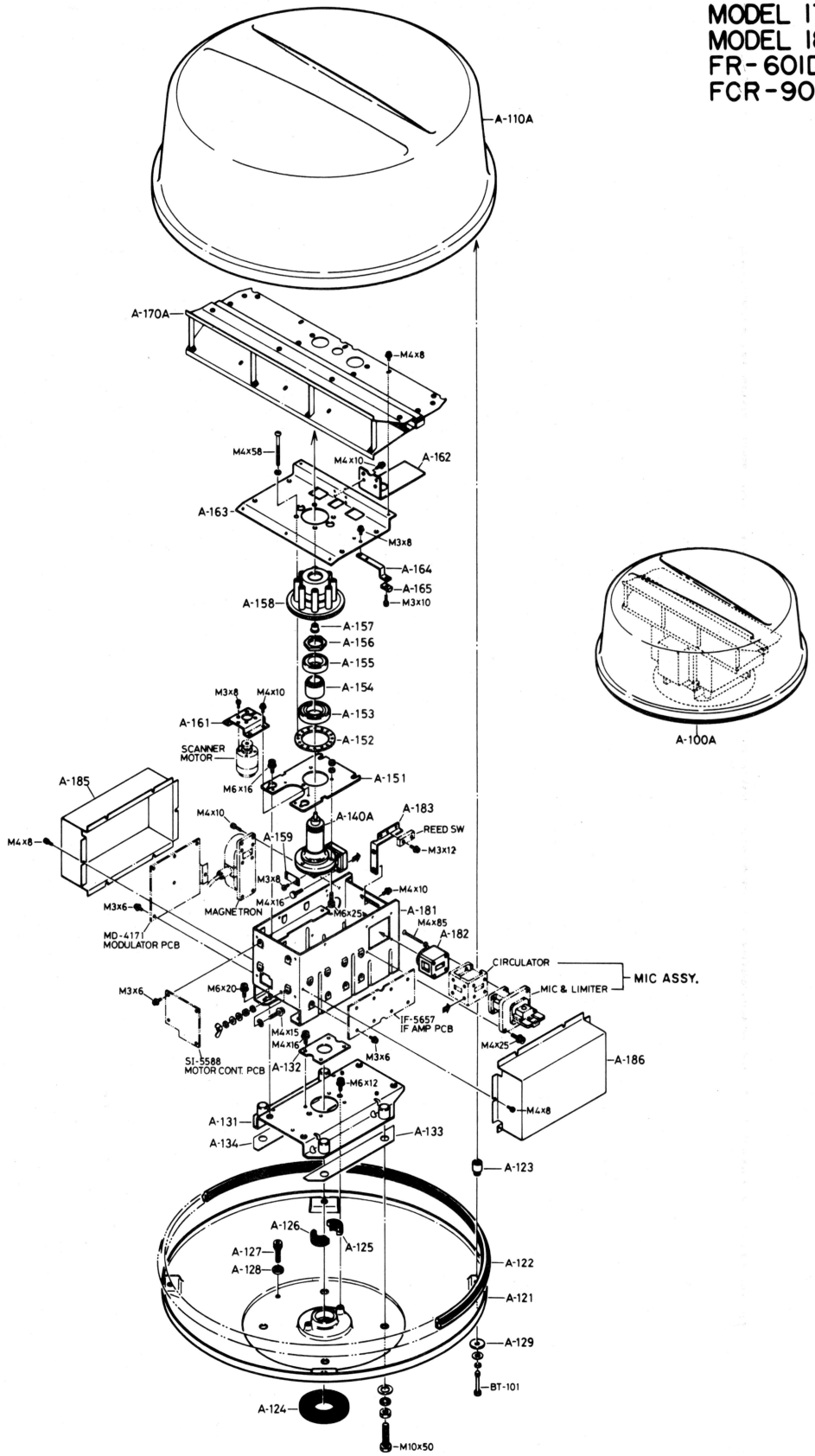
MODEL 1700

REV. : 1/86

FURUNO ELECTRIC CO., LTD.

S-5

MODEL 1700
MODEL 1800
FR-601D
FCR-901



APPROVED		TITLE	空中線部分解図 SCANNER UNIT
CHECKED			
DRAWN	MAR. 27.'85	DWG. NO.	C3289-013-A

FURUNO ELECTRIC CO., LTD.

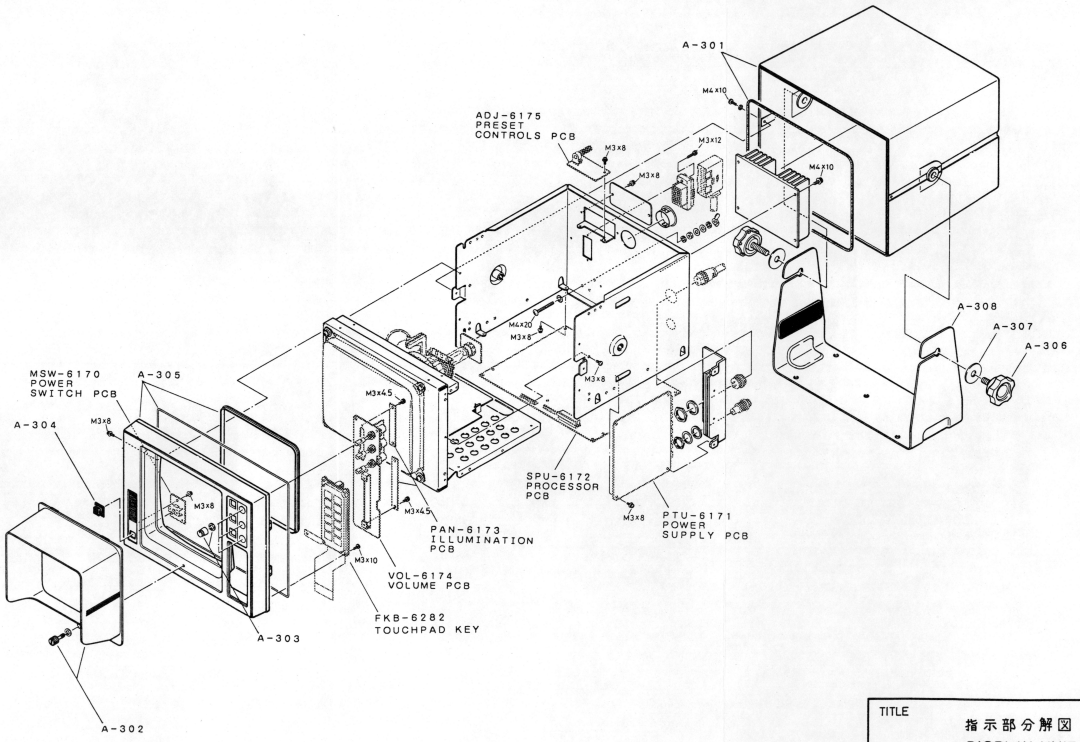
No. 9-52, ASHIHARA-CHO,
NISHINOMIYA-CITY, JAPAN

TELEPHONE : 0798-65-2111
CABLE : FURUNO NISHINOMIYA
TELEX : 5644-325/326 FURUNO J
TELEFAX : 0798-65-4200 (GⅡ/GⅢ)

YOUR LOCAL AGENT/DEALER

FURUNO

D-2



TITLE
指示部分解図
DISPLAY UNIT

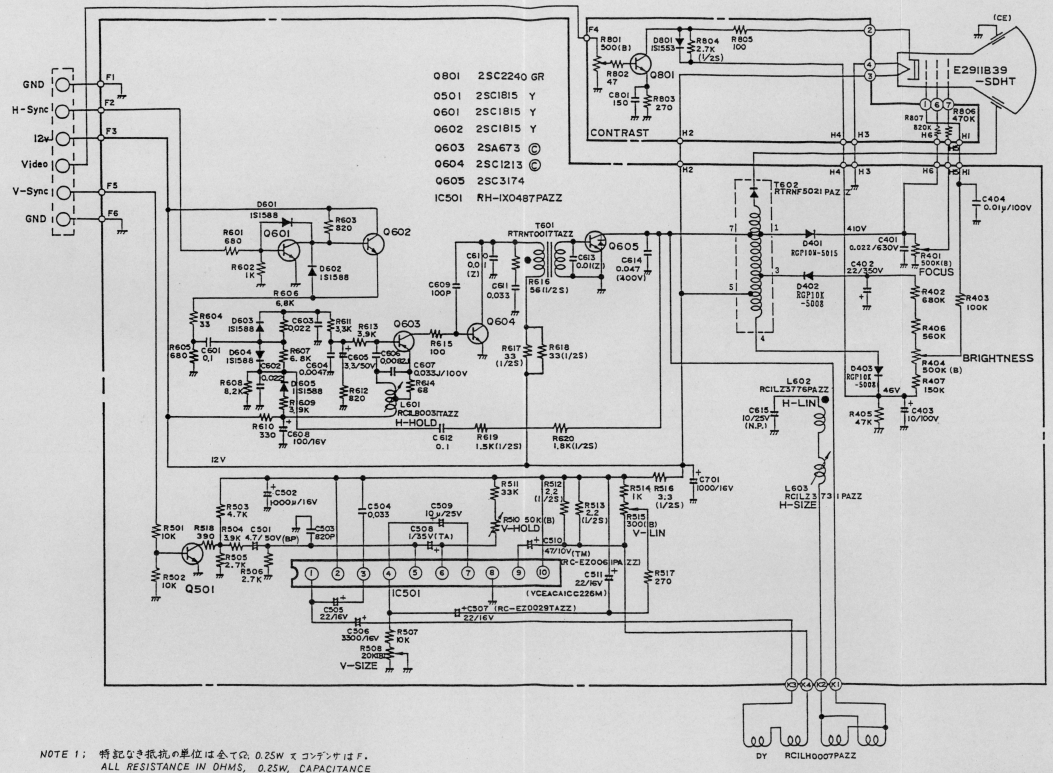
MODEL 1700

図番 DWG.NO. C3289-015-B

FURUNO ELECTRIC CO., LTD.

FURUNO

2/3



NOTE 1; 特記なき抵抗の単位は全てΩ, 0.25W で コンデンサは F.
ALL RESISTANCE IN OHMS, 0.25W, CAPACITANCE IN FARADS UNLESS NOTED OTHERWISE.

ITEM	NAME	MATERIAL	Q'TY	DWG.NO	REMARKS

MODEL 1761
MODEL 1751
MODEL 1731
MODEL 1721
MODEL 1760
MODEL 1750
MODEL 1730
MODEL 1720

承認 APPROVED	NOV. 13. '87 T.NAKANO	三角法 THIRD ANGLE PROJECTION	名称 TITLE 7" モノクローム・ディスプレイ CRT DISPLAY (A1QA9DSP45)
検図 CHECKED	NOV. 13. '87 I. AMANO	尺度 SCALE	
製図 DRAWN	12TH. NOV. '87 Y. HATAI	重量 WEIGHT kg	図番 DWG.NO. C3309-010-F

FURUNO ELECTRIC CO., LTD.